



British Guiana.

DIVISIONAL REPORTS

OF THE

DEPARTMENT OF AGRICULTURE,

FOR THE YEAR

1931.

GEORGETOWN, DEMERARA :

PRINTERS TO THE GOVERNMENT OF BRITISH GUIANA.

"THE ARGOSY" COMPANY, LIMITED.

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No. 15,968.

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NOTE.—Each report also contains its table of contents.

FOREWORD.

In this volume, the divisional reports of the Department of Agriculture of British Guiana for 1931 are to be found. It will, therefore, be seen that the procedure adopted this year is somewhat different from that of the previous year, since in the 1930 Administration Report of the Director of Agriculture, the divisional reports were appended. The present course has been followed since it appeared likely that if all reports were embodied in a single publication, the volume would have become rather bulky for easy reference.

2. It was intended originally that the divisional reports should be presented in two parts; one part covering the work of the specialist officers and the second part that of the agricultural officers. It will be seen, however, that departmental activities have been so co-ordinated that such a division cannot be too clearly defined since, with modern methods of investigation, the Entomologist, for example, spends as much of his time in the examination of the host plants and methods of control in the field as in the study of the pests in the laboratory; the Chemist equally distributes his time between the investigation of field problems and the examination of samples at his bench. Similarly, the trained agricultural officer, whether he be working with cane or with rice, must, in the investigation of his field problems, lay down trials whose plans are devised and results interpreted in the laboratory.

3. Most of the significant results from the work undertaken have been briefly summarised in my Administration Report but these fuller reports give, in detail, the problems investigated, the methods of procedure adopted, the results obtained as well as the various other matters which fall within the scope of each division. The reports serve primarily for record and reference purposes. They indicate the comparatively wide range of problems (and the different methods of their approach) which the Department is expected to solve. As pointed out in my Administration Report "there have been mentioned many lines of endeavour, the value of which can be appreciated only in the course of time, but during the period under review there has also been accomplished much which is more immediate in effect and some of which is already exerting an influence on local agricultural practices and outlook."

4. These reports do not contain any reference to the work of the Plant Breeder, whose salary is being provided from the Colonial Development Fund, and who assumed duty during the last quarter of 1931. The Central Rice Station, Georgetown, is now under the control of this officer whose first annual report will appear next year. Prior to the assumption of duty by the Plant Breeder, the rice work at the Station, since the re-organisation of the Department, has been supervised by the Agricultural Superintendent, East Demerara, whose report for the period under review is included herein.

J. SYDNEY DASH,
Director of Agriculture.

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DEPARTMENT OF AGRICULTURE.

REPORT OF THE BERBICE DIVISION FOR THE YEAR 1931.

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REPORT OF THE BERBICE DIVISION FOR THE YEAR 1931.

STAFF.

H. Macluskie, U.D.A. (Aberdeen)	—Agricultural Superintendent.
E. M. Morgan	—Agricultural Instructor.
H. B. France	—Agricultural Assistant.

GENERAL.

During the year regular tours have been carried out by the district agricultural staff and a large number of visits paid to farms especially in connection with the cultivation of pure line seed padi and other economic crops. Farmers are beginning to realise the benefits derived from using pure line seed, especially as regards increased yields. Due to the depression many small holdings are being cultivated and on the whole greater interest is being taken in agricultural work than previously. The padi barn which has been erected at Whim will be of great use in supplying the needs of the farmers in the Corentyne whilst the requirements of the farmers in the West Coast and Canje areas will be met from the bond at the old Customs Warehouse, New Amsterdam.

2. Mr. H. B. France returned from leave and assumed duties as Assistant Agricultural Instructor on February 2.

SUGAR.

3. *Experimental Work.*—The following experimental work was carried out in collaboration with the Cane Agronomist :—

- (1) The final application of manures (Sulphate of Ammonia) was made to the plant canes of the manurial trial at Port Mourant during January. This trial was initiated in December, 1930.
- (2) A manurial trial at Plantation Blairmont was reaped in April and manures re-applied to the ratoons in May.
- (3) A variety trial at Plantation Blairmont with 12 varieties of 7 replicates each was initiated in May.
- (4) A variety trial, similar to the one established at Blairmont, was planted at Pln. Port Mourant during May.
- (5) A variety trial was reaped at Pln. Port Mourant in September, and the following month a similar one was reaped at Pln. Blairmont.

Full details of the above experiments and the results obtained from them will be dealt with by the Cane Agronomist.

4. During the year forty-one visits were paid to sugar estates in the District.

RICE.

5. Rice work in the field has been mainly confined to the propagation of pure line Demerara Creole padi for future distribution to farmers through the medium of—

- (a) Controlled blocks grown for purchase and storage.
- (b) Competitions.

(a) Two pure line blocks were planted, one at Plantation Port Mourant and the other at Plantation Rosehall.

Both crops were grown under satisfactory conditions.

From Port Mourant 253 bags were purchased for storage in the barn at Whim, Corentyne, and from Rosehall 103 bags were purchased for storage at New Amsterdam.

(b) Two padi competitions were held in the district. Only pure line Demerara Creole was used.

From these competitions a total of 382 bags of pure seed was reaped. Of this total 80 bags were taken over for storage and re-sale, whilst the remainder was stored by competitors who obtained seed certificates from the Department for disposal as seed padi.

6. *Seed Certificates*.—All persons who grew pure seed and reaped a crop of good uniform padi were awarded the pure seed certificate. Forty-two certificates were issued.

7. *Padi Barns*.—At Whim, Corentyne, an entirely new building was erected by the Public Works Department. Subsequently a concrete drying floor was constructed adjoining this building. There are 253 bags of pure line Demerara Creole stored in the barn.

At New Amsterdam the old Customs Bond (upper storey) was fitted out as a padi barn. There are 165 bags stored at New Amsterdam.

8. *Rice Grading*.—This work has been greatly facilitated by the introduction of a Grantex Grading Machine during the year.

The following table shows particulars of rice examined at New Amsterdam :—

Month.	No. 2.	No. 3.	Broken.	Total.
January	781	•1,198	...	1,979
February	1,299	1,845	...	3,144
March	1,436	1,948	125	3,509
April	1,348	512	335	2,195
May	2,945	60	...	2,105
June	2,450	150	...	2,600
July	450	350	200	1,000
August	1,703	...	...	1,703
September	2,514	...	...	2,514
October	1,854	155	...	2,009
November	1,952	1,246	60	3,258
December	1,380	360	...	1,740
Total No. of bags	19,212	7,824	720	27,756

* Ungraded class.

CITRUS.

9. Interest in this branch of agriculture is chiefly confined to the river districts and is on the increase.

During the year, a block of about 6 acres of grapefruit was established by the Manager of Plantation Blairmont. The area is planted on the equilateral triangle system, the distance of planting being 30 feet. The area is well drained and sheltered.

His Worship the Mayor of New Amsterdam was also instrumental in establishing 100 budded grapefruit and orange trees on the back-dam in the town. This dam is a convenient site and should serve as a demonstration to farmers from the districts.

Four acres of budded citrus were planted by a river farmer at Plegt Anker and the same farmer has ordered sufficient trees for a further 30 acres.

Regarding limes, these do not attract the same attention as do grapefruit and oranges, but nevertheless, 3,900 seedlings received from the North West District were distributed during the year.

GROUND PROVISIONS.

10. *Experimental Work*.—A preliminary experiment in the manuring of sweet potatoes was carried out on the New Amsterdam Prison Farm in co-operation with the Prison Department. The variety used as indicator was that commonly grown on the farm—"Strong Man."

The lay-out was in the form of a randomised block with 8 treatments as indicated below and 6 replicates of each.

No Manure.

3 cwt. per acre of Sulphate of Ammonia.

3 " " " Potash.

3 " " Superphosphate.

3 " " Sulphate of Ammonia and 3 cwt. of Sulphate of Potash.

3 " " " " 3 cwt. of Superphosphate.

3 " " Sulphate of Potash and 3 cwt. of Superphosphate.

3 " " Sulphate of Ammonia, 3 cwt. of Sulphate of Potash and 3 cwt. of Superphosphate.

The size of the plots was 36 by 30.25 feet (equivalent to 1/40th. acre). Each plot consisted of 5 banks upon each of which four rows of cuttings were planted. Planting was completed on June 15. Supplying was carried out on June 24. Reaping was carried out between December 14 and 17 and the crop was divided by eye into marketable and unmarketable potatoes. The former were counted and weighed and the latter were weighed only.

The results were as follows :—

	Total weight lbs. per acre.	Marketable Potatoes lbs. per acre.	Unmarketable Potatoes lbs. per acre.	No. of marketable Potatoes per lb.
Plots containing Ammonia Sulphate ...	6,697	3,967	2,730	2.50
Plots not containing Ammonia Sulphate ...	3,063	1,342	1,721	3.48
Increases due to Ammonia Sulphate ...	3,634	2,625	1,009	...
Standard error of mean ...	264	181	...	0.21

The application of nitrogen, therefore, has increased the total yield by 3,634 lbs. per acre, which represents an increase of 2,625 lbs. marketable potatoes and an increase of 1,009 lbs. unmarketable potatoes per acre. This fertiliser also increased the size of the individual tubers. With sulphate of ammonia 2.50 potatoes weighed 1 lb. while without sulphate of ammonia 3.48 potatoes were required to weigh 1 lb. The other manures have no significant effect.

Assuming the price obtained for sweet potatoes is 2 cents per lb.

An increase of 2,625 lbs. per acre represents ... \$52.50 per acre.

Cost of 340 lbs. sulphate of ammonia
(approximately) ...

6.75

Profit

... \$45.75 per acre.

It should be emphasised that this experiment was undertaken in the first instance as an eliminating trial using fairly large dosages of ammonia, potash and phosphate on certain plots to obtain some indication as to what fertilizer was required, and as a preliminary on which to base a more economic trial with the fertilizer which proved the most successful. For example, although the most paying returns have been obtained with 3 cwt. sulphate of ammonia it is possible that equally good results would have been procured from a smaller application and this point will be further investigated. It is also intended to lay down during the coming year a further test for residual effects. Cost of fertiliser is always the determining factor; at present sulphate of ammonia is cheap and can be used to great economic advantage in many ways.

Rainfall during the crop was as follows :—

June.	July.	August.	September.	October.	November.	December.	Total.
7.62	0.86	3.49	3.48	4.10	3.51	3.06	37.12

11. *Nurseries of Sweet Potatoes.*—The following varieties were established in the Prison Compound with a view to propagating sufficient material to carry out a variety trial in 1932:—

<i>Name.</i>	<i>Local Origin.</i>
Black Sam	... Georgetown Station.
Black Rock	... "
Philippine	... "
Carolina Lea	... "
Red Nut	... "
Brook's Gem	... "
St. Vincent	... "
Pink Stem	... Essequibo Station
White Stem	... "
Milton	... "
Essequibo	... "
Garden Variety	... "

Of the above the following 7 were reaped from plots measuring 25 by 4 feet and the following observations made:—

<i>Name.</i>	<i>Colour Skin.</i>	<i>Colour Flesh.</i>	<i>Yield lbs.</i>
Brook's Gem	... White	White	47
Carolina Lea	... —	Light Yellow	26
Red Nut	... Red	White	18
St. Vincent	... White	—	18
Philippine	... Light Pink	—	15
Black Rock	... Red	—	9
Black Sam	... —	Yellow	6½

The above figures are of no statistical value but are included as they may prove of interest.

12. *Legumes.*—Plots of black eye peas, bush bonavist and mung have been established on the Prison Farm for further propagation with a view to the rotating of the crops now grown.

13. *Vegetable Growing.*—There is considerable interest being aroused in vegetable growing in the district generally and small market gardens are receiving attention at various centres with considerable success.

AGRICULTURAL EDUCATION.

General.

14. *Vegetable Garden.*—An attempt is being made to inaugurate a vegetable garden for boys for educational purposes at Whim, Corentyne, within the compound recently created behind the paddy barn. The land was fenced and prepared, and a few tools were purchased. The district is well populated and has three schools, and it is hoped that support will be forthcoming.

15. *Instructional Work.*—Instructional work has proceeded throughout the year by all officers, and a great variety of subjects dealt with.

Meetings of farmers and demonstrations have been held as occasion demanded and pure seed growing and production discussed and advocated, and vegetable growing encouraged with particular reference to those which are imported from abroad.

16. *School Excursion.*—A party of school boys was conducted over the manurial plots at the Prison Farm, and the various treatments explained.

Competitions.

17. In the Berbice District the following agricultural competitions were held during 1931 :—

- (1) For the best block of transplanted pure line padi (Autumn crop) on the West Coast (Bush Lot) and on the Upper Corentyne (Villages 70-72) the area to be not less than half an acre.
- (2) For the best miscellaneous farm on the East Bank, Berbice, between New Amsterdam and Mara.

Prior to inaugurating these competitions every effort was made to make them as widely known as possible through the agency of meetings, placards, distribution of pamphlets and personal contact. The rules governing the competitions were also fully explained.

18. *Padi Competitions.*—Entries for these were very satisfactory. On the Upper Corentyne 14 persons and at Bush Lot 40 persons recorded their names. Seventeen pounds of pure line Demerara Creole seed were distributed free to each competitor. The following were the points upon which the competitions were judged :—

- General layout and preparation of nurseries and beds.
- Uniformity of type of grain and freedom from red grains.
- Freedom from weeds, pests and diseases.
- Yield.

The seed had to be sown in nurseries and then transplanted. The crop had to be weeded and rogued of volunteer paddy and the crop had to be hand threshed.

19. The Corentyne competition was most unfortunate in that it failed to mature owing to the ravages of ducks which on that Coast can form a severe pest, and only two nurseries out of the fourteen were transplanted. The two surviving nurseries were successfully transplanted and reaped and their owners were promised that they would be granted a portion of the prize money, in view of the fact that through their efforts they had successfully warded off the ducks and so saved their crop.

From the two transplanted nurseries 26 bags of seed were reaped. The successful farmers were : Samaroo and Jagroop.

20. At Bush Lot, where 40 entries were recorded, the seed was sown in nurseries on June 1 after being soaked to hasten germination. The site of the competition was immediately behind Bush Lot Village, between it and the railway line, and was excellent for the purpose as persons going to and from aback walked on the centre dam which divides the two sections.

21. Growth in nurseries was good and transplanting commenced 28 days after sowing and was finished by July 15. Weather conditions were favourable throughout and water supplies were well maintained. Heavy showers were experienced from October 26 to October 31 and a large portion of the crop was laid. Little damage was done, however, to the grain. Of the 40 plots 7 were destroyed by trespassing cattle and of the remaining thirty-three, 21 plots did not measure the required half acre and so were disqualified. All plots were weeded and rogued according to conditions laid down and presented a very good appearance. Reaping, which was hand done throughout, commenced on November 3 and from the twelve plots which were of the half acre required, an average yield of $16\frac{3}{4}$ bags or $33\frac{1}{2}$ bags per acre was obtained. For reaping, each plot was carefully measured and demarcated to the required size to ensure accuracy and every bag was weighed to 143 lbs. gross.

22. Owing to the competitors having larger areas to reap on the back lands near the Abary Creek, reaping of competition plots was spread over a period of about a

month. As all conditions were adhered to throughout, final judging had to be on yield. The winning plot yielded 20 bags and 135 lbs. or over 41 bags per acre and reflected great credit on the grower. Prizes were allotted as follows:—

1st prize	—Jaimungal	—41 bags per acre.
2nd prize	—Ramcheritar	—38 "
3rd prize	—Mangalee	—35 "

The total quantity of seed grown on all plots amounted to 49,805 lbs. or 356 bags and 55 lbs., all of which is available for next year's seed supplies and it is gratifying to record that the sample is excellent, bright, uniform and free from red grains.

23. Considerable interest was evinced and the worth and quality of Demerara Creole was fully realised when compared to the results obtainable from the mixed variety of seed normally grown. Thus the increase in yield, purity and quality of the strain of padi used was fully recognised by the competitors and others. Interest in the competition was wide and general throughout the Coast and it is anticipated that enquiries will be centred upon Bush Lot for pure seed for the coming crop. It may be of interest to add that the age of the crop from sowing to maturity was 153 days or 5 months. This fact alone which was witnessed in the district is of great value because there was formerly a belief amongst farmers on the Coast that Demerara Creole was a 6 months' padi and therefore unsuited to local conditions. This belief is now refuted by practical demonstrations.

24. All competitors who reaped their plots in both competitions will receive the Department of Agriculture's pure seed certificate.

25. *Miscellaneous Farms Competition.*—The competition held last year amongst mixed farmers on the East Bank between New Amsterdam and Mara was repeated. Entries were more satisfactory and 16 as against 8 in 1930 were recorded.

The points upon which this competition was judged were as follows:—

Drainage	..	...	...	30
General layout and state of cultivation	..	...	...	30
Condition of crops, freedom from pests and diseases	..	...	...	20
Livestock (including poultry)	...	...	...	20

26. At the outset it is to be regretted that in no case was it possible to award points for livestock. A few people keep one or two fowls but in no instance was interest in livestock recorded. This is a pity because poultry and livestock are important adjuncts to good farming and are advocated as such. Drainage conditions generally were very good and satisfactory except that in several cases it was noted that the dirt removed from the drains was left on the parapets instead of being backed to the centre of the beds.

27. All competitors had very good cultivations in that the produce was well cared for and healthy and the land free from weeds, but, in almost every case, provisions were so mixed upon the beds that no system of land management prevailed. As regards permanent crops, a very important factor in farming, these are drawing attention of farmers and a few nurseries of orange, lime and cocoa seedlings were noted. Similarly with provisions, the chief faults regarding permanent crops were distance of planting and mixing. Coconuts, cocoa, coffee and citrus should not be mixed on any account.

28. Prior to final judging frequent visits were paid to competitors. The final visit was paid in the first week of November when Mr. H. T. King of Bramfield who acted as judge made the following awards:—

1st prize	...H. D. Chan, Plegt Anker	...80 points.
2nd prize (equal)	...Messrs. Aaron of DeKinderen and Daniels of Sebastapool	...78 points.

The winning farm exhibited considerable enterprise on the part of the owner and consisted on the one part of a banana and provision plantation and on the other of 4 acres of budded grapefruit interplanted with corn. The farmer has now reaped his corn and has interplanted his holding with black eye peas, whilst a further extension of about 30 acres under citrus is being prepared. The second place was tied for by Messrs. Aaron and Daniels. The former has a well established and well cared for orchard of grapefruit and oranges and mangoes 12 years of age and upwards from which large crops of fruit are picked annually. This holding reflects great credit on the owner who now reaps the reward of his forethought in the past. Besides the orchard the owner has a small vegetable garden the produce of which is sold on a neighbouring estate. Similarly, Mr. Daniels at Sebastapool, who last year won the first prize, has a very creditable holding consisting of bearing cocoa on the one part and a mixed orchard and provision area on the other.

29. It is to be recorded that this competition is assisting to create better methods of cultivation which are at all times advocated, and it is to be hoped that the good methods employed by some will soon be emulated by many.

SEED AND PLANT DISTRIBUTION.

30. Quantities of legumes and vegetable seeds including 9 lbs. of onion seed have from time to time been distributed to farmers and market gardeners, and some seedlings of tomato and cabbage given out.

A large quantity of Guatemala Grass tops were distributed to sugar estates and stock owners.

Orders for economic plants have from time to time been forwarded to the Botanical Division.

CO-OPERATIVE CREDIT BANKS.

31. There are 8 Co-Operative Credit Banks in the district. Of these 4 are under my chairmanship, and the remaining 4 on the Corentyne are under the chairmanship of the Agricultural Instructor, Corentyne.

Meetings have been held monthly.

MISCELLANEOUS.

32. *Soil Investigations.*—The Chemist Ecologist was accompanied up the Kilmarnock Ketting in February, and soil samples from the Kilmarnock-Springlands Empolder were obtained.

In August a trip was made up the Berbice River with the Chemist-Ecologist to inspect certain old Dutch estates. Eight estates were visited and a full report submitted.

In September the following soil samples were procured on Plantation Blairmont and submitted to the Chemical Division for examination :—

- (a) Composite soil sample of non-potash area.
- (b) " " " area treated with filter press mud.
- (c) " " " " untreated with filter press mud.
- (d) " " " typical heavy clay.
- (e) " " " " pegasse.

An inspection tour was made up the Canje Creek in November, and a point about 25 miles above Ikuruwa was reached. The savannah was inspected at the fringe, and soil and grass samples were taken and submitted for examination.

The Agricultural Instructor for the Corentyne made an inspection of the Corentyne river as far as Orealla.

33. *New Amsterdam Gardens.*—These gardens were taken charge of in April, and an attempt has been made to create large expanses of lawns with occasional

flower beds. Considerable cleaning up has been carried out. A mowing machine supplied by the Prison Department has greatly facilitated work on the lawns.

34. *Specimens*.—27 specimens were submitted to the Botanical Division for identification. Of these a *Phaseolus* spp. collected aback of the Kilmarnock-Springlands Empolder was previously unrecorded.

35. *Correspondence*.—231 items of correspondence were despatched, and 437 received. The following reports were submitted to the Director during the year :—

Report on certain old Dutch Estates on the Berbice River.

Report on the agricultural possibilities of Ithaca district.

Report on the coconut industry.

Availability of agricultural lands for development.

Report on the agricultural competitions.

Report and estimate of the rice crop.

Reports on the collection of outstanding debts of the co-operative credit banks on the West Coast, Berbice.

Monthly progress reports.

Fortnightly reports of market prices.

36. *Publications*.—Rice Variety Trials in Field Test Plots at Plantation Port Mourant, 1930.

37. *Rainfall recorded at New Amsterdam Gardens*.—

January	...	...	8.73 inches.
February	...	...	6.25 "
March	...	...	2.29 "
April	...	...	6.51 "
May	...	...	16.43 "
June	...	...	9.89 "
July	...	...	11.86 "
August	...	...	3.46 "
September	...	...	4.56 "
October	...	...	3.36 "
November	...	...	5.68 "
December	...	...	7.36 "
			86.38 "

38. *Acknowledgment*.—In conclusion I wish to record my appreciation of the loyal co-operation of the Staff throughout the year.

My sincere thanks are extended to Managers and personnel of estates and all agriculturists for many courtesies.

HECTOR MACLUSKIE,

Agricultural Superintendent,
Berbice.

January 14, 1932.

DEPARTMENT OF AGRICULTURE.

REPORT OF THE EAST DEMERARA DIVISION FOR THE
YEAR 1931.

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REPORT OF THE EAST DEMERARA DIVISION FOR THE YEAR 1931.

STAFF.

E. M. Peterkin—Agricultural Superintendent.
C. C. Dowding—Agricultural Instructor, East Coast District.
D. D. Haynes —Agricultural Instructor, Mahaica-Mahaicony District.
J. Indrobeharry—Agricultural Assistant, Experiment Station.

GENERAL.

1. The usual visits and inspections were made to both small holders and estate cultivations during the year. The depression has resulted in larger areas being planted with rice and ground provisions.

2. A Rice Farmers' Day was held at the Experiment Station on Wednesday, October 14, and those attending were conducted around the plots by the Acting Director and the Agricultural Superintendent. The Acting Director lectured on the benefits derived from growing pure seed, and explained the aims and object of the very exhaustive manurial experiment then being carried out.

3. The southern side-line has been deepened throughout its entire length. The levels for this were kindly taken by the Public Works Department. Opportunity was also taken at the same time to deepen the façade trench of the Botanic Gardens; this has made a considerable improvement in the drainage. The side-line to the livestock area has also been deepened.

4. Two new Canadian fencing gates have been fitted to the entrances to the station, and the padi bond has been reconditioned. Two new greenheart box kokers have been put down; one across the trench between North-East and North-West Fields to conduct irrigation water into the latter field; and the other between North-West Field and the adjoining bush for supplying the Front Gardens with water in dry weather. The old ones were in use for over 25 years and no longer functioned satisfactorily.

5. I was placed in charge of the Department's Stand at the Centenary Fair, where a large number of exhibits were greatly admired by the many thousands of visitors who passed through during the three days' Exhibition.

EXPERIMENT STATION, GEORGETOWN.

Rice.

6. The area under experiment in this crop at the Georgetown Rice Experiment Station was, during the period under review, $17\frac{1}{2}$ acres; of this 2 acres were under Progeny Row Plots for pure seed selection, $1\frac{1}{2}$ acres under a randomised varietal experiment, 4 acres under a manurial experiment, and the remainder—10 acres—under Demerara Creole and H. 7 for multiplication of pure seed and eventual distribution to farmers.

7. *Variety Experiment.*—A randomised variety experiment was carried out during the Autumn Crop. Six varieties were selected from the experiment carried out in 1930; these were Demerara Creole, H. 7, Blue Stick, No. 75, No. 76 and No. 79.

8. The trial was laid out accordingly in three latin squares. Each plot was $\frac{1}{80}$ th. of an acre (23 ft. 4 ins. x 23 ft. 4 ins.). A strip of the same variety was planted around each plot to eliminate boundary effect.

9. The nurseries were sown on June 1, the seedlings transplanted on July 6 and the plots reaped on October 26–30. The yield of each plot was weighed to the nearest $\frac{1}{4}$ oz.

10. The variety yields in bags padi (140 lbs.) per acre and as a percentage of the general mean are as follows :—

	79.	H. 7.	D.C.	76.	75.	B.S.	Mean.	Standard error of mean.
Bags padi per acre ...	24.41	22.97	22.87	21.77	20.77	16.54	21.50	0.417
Per cent. ...	113.6	106.9	105.0	101.3	96.63	76.93	100.0	1.94
Yields bags padi per acre in 1930 ...	23.94	24.94	22.00	22.24	22.11	20.95	+	—

11. The statistical analysis of the experiment shows that any difference in the mean yields greater than 1.87 bags padi per acre is due to a difference in variety.

12. Blue Stick is the poorest yielder under the conditions of the experiment ; it was noticed during the trial that Blue Stick suffered from some disease of the leaves. This disease is under investigation.

75 is inferior to H. 7 and 79.

There are no differences in yield between 75 and 76.

13. There was no significant difference between H. 7, D.C. and 76. They are better than Blue Stick but inferior in yield to 79.

14. There was no significant difference between 79 and H. 7, but there is a strong probability that 79 is the better variety.

15. The yields of the three latin squares in bags padi per acre and as a percentage of the general mean are given below :—

	A.	B.	C.	Standard error of mean.
Bags padi per acre ...	21.6	22.5	20.0	0.295
Percentage ...	100.4	104.8	93.0	1.37

16. The order of merit of the varieties in the separate squares showed no definite signs of alteration *i.e.*, the different growth conditions of the three squares made no difference to the relative yields of the different varieties.

17. The arrangement of the experiment is admirably suited to the investigation in hand. The standard error of the variety means, stated as a percentage of the general means, reached the low figure of 1.94 per cent. (last year it was 2.84 per cent.). This reduction of the standard error has allowed subtler differences to be detected between the variety yields than was possible last year.

18. A milling test was made at Ramnarine Pundit's rice mill in Albouystown and the results are as follows :—

Variety.	Weight of padi. lbs.	Weight of rice. lbs.	Per cent. broken and discoloured grains.	Grade.
No. 75 ...	100	67	19.0	No. 1
No. 76 ...	100	64	16.8	No. 1
No. 79 ...	100	69	7.0	Super
H. 7 ...	100	68	23.6	No. 1
Demerara Creole ...	100	68	18.9	No. 1
Blue Stick ...	100	65	9.3	Super

19. *Manurial Experiment.*—A comprehensive manurial experiment was laid down during the Autumn Crop to determine the effect on the yield of padi by separate and combined fertilizer treatments.

20. The variety used was H. 7, the area of the plots 1/80th. of an acre, i.e., 23 ft. 4 ins. x 23 ft. 4 ins., and the arrangement eight randomised blocks each containing 32 plots.

The treatments were as under :—

- Control.
- Ground Limestone—1 ton per acre.
- Superphosphate of lime—240 lbs. per acre.
- Sulphate of Ammonia—160 lbs. per acre.
- Sulphate of Potash—80 lbs. per acre.
- Green Manure (Rice straw)—1 ton per acre.
- Every possible combination of the above.

21. The nursery for this was sown on June 30 transplanted on August 4 and the plots reaped on November 17.

22. To enable this experiment to be carried out it was necessary to change the entire irrigation and drainage system of approximately 5 acres. Bunds were built to enclose the required area, and drains dug to irrigate and drain each individual plot. During their growth careful notes were made of the date of flowering, incidence of “man rice,” lodging, &c., and on November 10 the plots were judged as to the uniformity of ripening. On the plots being reaped and weighed the results were forwarded to the Chemist-Ecologist who has examined the figures statistically and supplied the following information :—

23. *Flowering Dates* : An analysis of the variance is as follows :—

Variance due to			Degrees of freedom.	Sum of squares.	Variance.	$\frac{1}{2} \log_e \times \text{variance.}$	Difference.
Treatments	...	...	31	38	1.226	0.1017	...
Blocks	...	...	7	23	3.285	0.5946	0.3974
Error	...	...	217	322	1.484	0.1972	...
Total	...	...	255	383	...	...	...

It will be seen that the various manurial treatments had no effect on the flowering date of the padi.

24. *Man Rice*.—Analysis of the variance is as follows :—

Variance due to			Degrees of freedom.	Sum of squares.	Variance.	$\frac{1}{2} \log_e \times \text{variance.}$	Difference.
Treatments	...	...	31	507	16.35	1.397	0.170
Blocks	...	...	7	1,237	179.57	2.595	1.366
Error	...	...	217	2,526	11.63	1.227	...
Total	...	...	255	4,290	...	...	...

The variance due to manurial treatment can hardly be judged significant.

25. The factors affecting the distribution of “man rice” are hard to assess, and very baffling. It is unlikely that the influences responsible for retarded flowering are those affecting the incidence of “man rice.” The Block IV., one of the last to flower, contained significantly less “man rice” than did the other blocks. The differences may be due to soil variation either in the blocks or in the original seed bed. Although the manurial treatments brought about no significant differences yet there are indications that dressings of sulphate of ammonia decrease, and applications of limestone increase, the incidence of “man rice.” An hereditary factor may be the most influential in the production of “man rice.” This trouble continues to receive the careful study of the Botanist and Mycologist.

26. *Lodging*.—Some fortnight before the date of reaping of the trial, about November 5, each plot was judged according to the amount of lodging observed. Each plot was put into one of three classes;—

- (1) Rice standing erect (lodging nil).
- (2) Rice lodging here and there (50 per cent. lodging).
- (3) Rice beaten flat (100 per cent. lodging).

27. The results were examined statistically with the following results :—

Variance due to			Degrees of freedom.	Sum of squares.	Mean square.	$\frac{1}{2} \log_e$ mean square.	Difference.
Blocks	...	...	7	32.2	4.630	1.914	1.224
Treatments	...	...	31	51.9	1.673	1.409	0.719
Error	...	...	217	85.2	0.2975	0.690	...
Total	...	...	255	170.3	...	...	...

28. Lodging has been significantly increased by phosphate applications, by nitrogen applications and by rice straw applications. Additions of lime to applications of superphosphate increased the effect of the latter fertilizer.

29. *Ripeness*.—The individual plots of the trial were judged on November 10, as to their ripeness. The plots were put into one of the following classes :—

- (1) Green.
- (2) Half-ripe.
- (3) Ripe.

30. Dressings both of phosphate and of ammonia have hastened maturity, lime in the absence of phosphate retards ripening, and phosphate in the presence or absence of lime hastens ripening. Additions of rice straw to the potash plots increase the ripening rate.

31. *Yields*.—An analysis of the variance of the yields is as follows :—

ANALYSIS OF VARIANCE—LBS. PER PLOT.

			Degrees of freedom	Sum of Squares.		Sum of Products.	Correlation.
				Padi.	Straw.		
Blocks	...	...	7	778.44	13778.50	+ 23.883	+ 0.7050
Treatments	...	...	31	787.31	19490.99	+ 1669.11	+ 0.4281
Error	...	...	217	2553.00	72027.75	+ 3370.43	+ 0.2485
Total	...	...	255	4118.75	105297.25	+ 7348.42	+ 0.3529

32. For the padi yields the extended analysis is :—

		Degrees of freedom.	Sum of squares.	Variance.	$\frac{1}{2} \log_e V.$	Difference.	Z for P 0.05.
Blocks	...	7	778.44	111.206	2.355	1.122	0.4034
Treatments	...	21	787.31	25.397	1.618	0.385	0.2654
Error	...	217	2553.00	11.765	1.233	...	...
Total	...	255	4118.75	16.152	...	...	...

33. There are significant differences in the yields of padi from the eight blocks into which the experiment was divided. The effect of manurial treatment on the padi yield is also definite.

34. Only the treatments differences of phosphate and rice straw and the interaction between the nitrogen and potash are significant.

35. The analyses of variance of the straw yields are:—

	Degrees of freedom.	Sum of squares.	Variance.	$\frac{1}{2} \log_e V.$	Difference.	Z for P 0.05
Blocks	7	13778.50	1968.36	3.793	0.890	0.4064
Treatments	31	19490.90	628.74	3.222	0.319	0.2654
Error	217	72027.75	331.93	2.903		...
Total	255	105297.25	...	...	...	..

36. There are significant differences in the yields of straw from the eight blocks into which the experiment was divided. The effect of manurial treatment on the straw yield is also definite.

37. The treatments of phosphate, of lime, of ammonia, of potash, and the interaction of potash and rice straw have a significant effect upon the yield of straw.

38. The actual yield differences of padi and straw and the different intensities of lodging due to the various treatments are shown below. The differences marked with an asterisk are definitely significant.

	PADI.		STRAW.		LODGING.	
	Bags. acre.	Per cent.	Tons. acre.	Per cent.	Mark plot.	Per cent.
Phosphate—no P	1.10*	5.0*	0.306*	9.4*	0.725*	30.0*
Lime—no L	-0.28	-1.3	-0.189*	-5.8*	0.023	0.1
Ammonia—no N	0.20	0.9	0.264*	8.1*	0.305*	12.6
Potash—no K	-0.11	-0.5	0.185*	5.7*	-0.039	-1.6
Straw—no Straw	0.58*	2.6*	0.085	2.6	0.274*	11.3*
Standard Error	0.17	0.79	0.0576	1.75	0.0557	2.3
Mean	21.92	100.00	3.30	100.0	2.42	100.0
P L—(no P no L)	0.82*	3.7*	0.117	3.6	0.750*	31.0*
P N—(no P no N)	1.30*	5.9	0.370*	17.6*	1.030*	53.7*
P K—(no P no K)	0.57*	4.3*	0.491*	15.1*	0.688*	28.4*
P S—(no P no S)	1.67*	7.6*	0.390*	12.0*	1.010*	41.4*
L N—(no L no N)	-0.07	-0.3	0.076	2.3	0.328*	13.6*
L K—(no L no K)	-0.39	-1.8	-0.003	-0.1	-0.016	-0.1
L S—(no L no S)	0.25	1.1	-0.104	-3.2	0.297*	12.3*
N K—(no N no K)	0.09	0.4	0.450*	13.9*	0.266*	11.0*
N S—(no N no S)	0.77	3.5*	0.349*	10.8*	0.578*	23.9*
K S—(no K no S)	0.46	2.1	0.270*	8.3*	0.231	9.6
Standard Error	0.245	1.1	0.0813	2.46	0.0788	3.3
P L N—(no P no L no N)	1.16*	5.3*	0.364*	11.2*	1.006*	41.4*
P L K—(no P no L no K)	0.79	3.6	0.302	9.3	0.656	27.2
P L S—(no P no L no S)	1.36*	6.2*	0.171	5.3	0.969	40.0
P N K—(no P no N no K)	1.02	4.7	0.787*	24.3*	1.000	41.4
P N S—(no P no N no S)	1.44*	6.6*	0.695*	21.4*	1.188*	49.0*
P K S—(no P no K no S)	1.45*	6.6*	0.600*	18.5*	0.906*	37.5*
L N K—(no L no N no K)	0.22	-1.0	0.367*	11.3*	0.375	15.5*
L N S—(no L no N no S)	0.48	2.2	0.039	1.2	0.563*	23.3*
L K S—(no L no K no S)	0.33	1.7	0.173	5.3	0.250	10.3
N K S—(no N no K no S)	0.57	2.6	0.570*	17.6*	0.500*	20.7*
Standard Error	0.346	1.6	0.1152	3.5	0.1115	4.6
P L N K Minus no (P L N K)	1.36	6.2	0.685*	21.2*	1.000*	41.4*
P L N S Minus no (P L N S)	1.24	5.7	0.335	10.3	1.061*	43.9*
P N K S Minus no (P N K S)	0.96	4.4	0.970*	29.9*	1.061*	43.9*
L N K S Minus no (L N K S)	0.87	4.0	0.455	14.0	0.562	23.2
P L K S Minus no (P L K S)	1.40	6.4	0.471	14.5	0.812*	33.6*
Standard Error	0.49	2.2	0.1626	4.9	0.1576	6.5
P L N K S Minus no (P L N K S)	1.23	5.6	0.896*	27.7*	0.875*	36.2*
Standard Error	0.69	3.2	0.230	7.0	0.2229	9.2

39. Considering the padi yields it will be seen that the biggest increase is obtained by dressings of superphosphate and rice straw. The increase (1.67 bags (140 lbs.) per acre) does not pay for the cost of the manures. No dressings definitely depress the yield of padi.

40. The biggest increase in the straw yield is obtained by a mixed dressing of phosphate, nitrogen, potash and rice straw. The single manurial applications of phosphate, ammonia and potash definitely increased the weight of straw. An application of limestone brought about a significant decrease in the weight of straw.

41. The most pronounced lodging was induced by a dressing of phosphate and nitrogen. Single dressings of phosphate, nitrogen and rice straw definitely accentuated the tendency to lodge.

42. The rice straw applied at the rate of one ton per acre, had the following analysis :—

Per cent.			Air dry basis.	Weight of constituents applied at 1 ton per acre rate.
Ash	...	...	17.7	3.5 cwt.
Nitrogen	...	...	0.591	13.2 lbs.
Carbon	...	...	29.8	...
P ₂ O ₅	...	...	0.415	9.3 „
K ₂ O	...	...	1.148	25.6 „
CaO	...	...	0.190	4.3 „
C/N	...	...	50.6	...

43. Thanks are due to the Chemical Division for its collaboration and help in this important trial.

COMPETITIONS.

44. During the year two Rice Farmers' Competitions were held in the East Demerara District, one on the Lower East Coast and one in the Mahaicony District.

45. The variety of padi used was Demerara Creole. In the case of new entrants pure seed was supplied from the Georgetown Station; cultivators who had grown padi from pure seed the previous season were allowed to compete provided the Agricultural Officer was satisfied as to its purity.

46. The majority of the competitors were induced to reserve sufficient seed for future supply.

47. Prior to the inauguration of these competitions every effort was made to make them as widely known as possible by the distribution of pamphlets and by personal "talks." The rules governing the competition were also carefully explained.

48. Throughout both of these competitions instructions were given by the Agricultural Instructor of the District and frequent visits paid during and between each operation. The value of these competitions can be gauged by the increased demand for pure line seed, and during the year over 300 bags were distributed in this district alone, sufficient to plant 1,200 acres.

49. *Lower East Coast (Kitty-Mahaica).*—The entries in this district were confined to Pln. Belfield and Pln. Nonpareil. The competitors at Belfield, however, did not carry out instructions given or conform to the rules laid down and were disqualified early in the competition. Twenty entries were received from Nonpareil and of these sixteen came through to the final judging. The management of this estate deserve great credit for the keen and personal interest taken in the competition not only for the encouragement given to the cultivators but also for the frequent visits paid to the plots.

50. The seed was sown in the nursery at the rate of 20 lbs. to three square rods, and the seedling transplanted at 4½ weeks old at the rate of two or three to a clump. The nurseries suffered damage by accidental flooding with salt water, and this caused the death of a large number of seedlings. This loss, however, was replaced by supplies from the Georgetown Experiment Station.

51. The prize-winners were as follows :—

Algoo	...	1st prize—\$25
Kurmiah	...	2nd prize—\$15
Ramsingh	...	3rd prize—\$10

52. *Mahaicony District (Mahaica-Abary)*.—At Mahaicony there were entrants from Sophia's Hope, Blenheim, Yorkshire Hall, Good Faith and Drill.

53. With regard to the competitions in this District it is interesting to note that while new entrants used pure line seed paddy those farmers who participated in the competitions in 1930 had reserved sufficient seed for their own use from their plots. This applied more especially to the farmers from Sophia's Hope. There were twenty-four entrants from this district but, unfortunately, the dry weather which prevailed just before and after the flowering period ruined all the plots, the padi having the appearance of being scorched. The entrants at Yorkshire Hall and Good Faith failed to comply with the rules and were disqualified.

54. The five entrants at Drill, however, carefully complied with the rules laid down and came through satisfactorily.

55. It is noteworthy that three ploughings and improved inter-cultivation had a very beneficial effect on yields and purity, although some of the competitors lost marks due to their failure to destroy volunteer plants before reaping.

56. The interest shown in these competitions has been considerable, and the worth and quality of Demerara Creole were fully realised when compared with the results obtainable from the mixed variety of seed normally grown. Thus the increase in yield, purity and quality of the strain of padi used were fully recognised by the competitors and others. It may be of interest to add that the age of the crop from sowing to maturity was five months. This fact alone which was demonstrated in the district is of great value because formerly there was a belief amongst farmers on the Coast that Demerara Creole was a six months' padi and therefore unsuited to local conditions. This belief is now refuted by practical demonstrations.

57. The prize-winners were as follows :—

H. C. Wordsworth	...	1st prize—\$25
Parsaudy and Danpattiah	...	2nd prize—\$15
Tomby	...	3rd prize—\$10

GROUND PROVISIONS AND VEGETABLES.

58. *Plantains*.—The observation plots laid down in 1929 were continued. All the beds have steadily deteriorated in number and size of bunches produced until, at time of writing, the stumps present a stunted, ragged appearance. It is intended to sow this area with legumes.

59. The varieties under cultivation are :—Surinam, Horse, Giant, Black Stem, Pink Stem, White Stem.

60. *Bananas*.—These are doing well. Large numbers of suckers have been distributed of the Gros Michel, Lacatan, Dwarf, Giant Fig and Congo varieties. The following varieties are under cultivation :—

Cayenne, Jamaica, Jamaica Red, Gros Michel, Dwarf, Giant Fig, Lacatan, Congo, Apple Fig, Sucre Fig, Cocerite Fig, Lady's Finger Fig, Red Fig, Large Fig, Almeida, Dacca, Rubra, Ramkela, Siam, Palembang, Celat, Serah, Martinique, Martaban, Pisang Su Su.

61. *Peas and Beans*.—The collection of Pigeon Peas established in 1930 is doing well. Large quantities of seed have been harvested and distributed. The following varieties are under cultivation :—

Barbados—large grey seeded, Local—small grey seeded, Local—small brown seeded, New Era, Silvios, Americanos, Negros, Dominica 813, Larcenos 4446, Cadios, Acebenos 4447, Acebenos 4448, San Salvador, Manchados, Horacios, Mites, New Era strain X, New Era strain D, Indian Pea.

62. Large quantities of seed of the following pulses have been distributed :—

Bush Bonavist, Bonavist (vine), Waby Bean, Wax Bean, Yard Bean, Butter Bean, Lima Bean, Mung, Urd.

63. *Onions*.—Owing to the unsatisfactory germination results obtained by the farmers who purchased seed from the Department, and which is entirely due to careless preparation of seed beds, it was decided to establish large nurseries at the Experiment Station in Georgetown and at Cecelia. The methods adopted were to distribute seedlings free to approved farmers on the following conditions :—

- (a) That the land had been properly prepared to the satisfaction of the Agricultural Instructor of the District ;
- (b) Visits to be paid by farmers to either station to see how the seed beds should be prepared.

64. This arrangement, it is hoped, will enable them to grow satisfactorily their onions during the coming year.

65. *Sweet Potatoes*.—The most promising of the varieties imported last year were :—

Black Rock, Black Sam, Six Weeks, Philippine.

In addition, the following varieties are under cultivation :—

Black Sam, Black Rock, Red Nut, Six Weeks, Trinidadian, Carolina Lea, Brook's Gem, St. Vincent, Philippine, Milton, Strongman and Garden.

66. A collection of all the varieties has been sent to the Agricultural Superintendent, Berbice, and the Agricultural Superintendent, North West District. Large numbers of cuttings have been distributed to farmers.

TOBACCO.

67. The demand for tobacco seed has continued. The seed collected from the varieties planted in 1930 has nearly all been distributed. The following varieties have again been planted this year for seed :—

Yellow Mammoth, Kentucky One Sucker, Maryland Broad Leaf, Ward's Burley, Vaughan's White Burley, Comstock Spanish, Improved Gold Leaf, Hickory Pryor, Azores Superior Type, Sumatra A, Warne, Big Havana, Rupununi (Major Walker).

FODDER CROPS.

68. The demand for Demerara Primrose, Uba Cane and Elephant Grass has increased considerably.

69. Wynne Grass has made extraordinary growth. Numerous rooted plants have been distributed, including supplies to the Rupununi. Reports from this District are awaited with great interest.

70. The original rows planted from cuttings of Guatemala Grass obtained from Trinidad in February, 1930, have been continually cut for extension and are still ratooning vigorously.

GREEN MANURES.

71. The following varieties are under cultivation and small quantities of seed are available for distribution :—

Crotalaria sericea, *C. usaramoensis*, *C. juncea*, *C. striata*, *C. quinquifolia*, *C. retusa* and an unknown variety, Woolly Pyrol, Black creeping Gram (*Phaseolus Mungo* var. *radiatus*), Troit Cowpea (*Vigna catjang*), Victor Cowpea, Conch Cowpea, *Indigofera hirsuta*, *Indigofera* (unknown variety introduced from Essequibo), *Tephrosia Hookeriana*, *Dolichos lablab*, *D. hosei*, Bush Bonavist, Yokohama (*Stizolobium deeringianum*), Arlington (*S. nireum*), 46448 (*Stizolobium* sp.), *S. aterrinum*, *Canavalia ensiformis* (white seeded), *C. gladiata* (Pink seeded), *Canavalia* sp. (Red seeded), *Centrosema pubescens*, *Desmodium tortuosum*, *Phaseolus semi-erectus*, *Sesbania sericea*, *Calapagonium muconoides* (Trinidad).

FIBRES.

72. *Manilla Hemp*.—The twelve suckers obtained from St. Vincent in July 1930, have grown fairly well and tillered freely. These will be extended in 1932.

SEED DISTRIBUTION.

73. Plants, cuttings and seeds of field crops were distributed from the Central Station alone during the period under review to farmers and others are given in the following summary :—

Padi ...	...	56,892 lbs.
Bengal Beans	...	111 "
Pigeon Peas	...	32 "
Papaw seed	...	$\frac{1}{2}$ "
Papaw plants	...	108 fruit.
Sweet Potato cuttings	...	42,000 "
Jerusalem Artichokes	...	191 lbs.
Sour Orange seed	...	20 "
Banana suckers	...	1,447 "
Plantain suckers	...	762 "
Beans	...	40 lbs.
Black Eye Peas	...	756 "
Broom Corn	...	5 "
Jute ...	...	3 "
Onion Seedlings	...	24,000 "
Onion Seed	...	5 lbs.
Miscellaneous Legumes	...	400 "
Mung	...	40 "
Tobacco	...	4 "

Fodder Crops.—

Demerara Primrose	...	1,000 plants.
Elephant Grass	...	12,500 cuttings.
Uba Cane	...	100 "
Guatemala Grass	...	300 "
Wynne Grass	...	6 boxes plants.

74. Considerable quantities of seeds and seedlings of vegetables were also distributed not only to farmers and others in the East Demerara District, but to other parts of the Colony including the Rupununi District and the Mazaruni Mining District.

LODGE VILLAGE ALLOTMENTS.

75. These allotments were started in May with the object of affording occupation to a selected number of unemployed and also for establishing a market garden near Georgetown; funds for this purpose being provided from Unemployment Relief Works. The area chosen is on Crown lands in the vicinity of Lodge Village

adjoining the Experiment Station. Fifty-nine allotments—one allotment to each cultivator—have been taken up (of approximately one-quarter of an acre each in extent) for ground provisions and vegetable cultivation. The land is being leased for one year free of rent. There are 13 ex-soldiers among the 59 allotment holders.

76. The conditioning of the area which was under high bush is directly under the supervision and control of the staff of the Georgetown Experiment Station. The cost of bringing this area into cultivation has been approximately \$400, it being agreed that Government would pay half the cost of digging the main irrigation and drainage trenches, the other half being met by those who intended to occupy the land. Each man is responsible for the internal drains affecting his allotment.

77. Banana and plantain suckers, cuttings of imported sweet potato varieties and seeds of various vegetable crops have been supplied to the farmers for planting as under :—

Plantains	...	...	750 suckers.
Bananas	...	...	1,357 "
Sweet Potatoes	...	...	21,000 cuttings.
Beans	...	...	13½ lbs.
Black Eye Peas	...	...	485 "
Pigeon Peas	...	...	4½ "
Jerusalem Artichokes	...	...	71 "
Onions	...	...	3,600 seedlings.

78. Several of the allotments have been taken away from the original holders on account of neglect and re-allocated. Later, sixteen plots were sub-divided and allocated to members of the Labour Union, but only four of these men have made any serious attempt to cultivate their allotments, consequently the beds were again re-allocated. In spite of these failures, a number obtained some excellent crops of black eye peas and sweet potatoes.

79. Three awards were made at the end of the year of \$10 each for the three best miscellaneous gardens established under the Lodge Village market scheme.

80. The prize-winners were as follows :—

- (1) S. George—Allotment No. 50.
- (2) A. Sills— " " 44.
- (3) J. West— " " 45.

SCHOOL GARDENS.

81. A small garden was started at Beterverwagting village under the auspices of the Chairman, Mr. Straughn. A committee was formed consisting of the Village Chairman, the School Managers, Head Teachers and the District Commissary, and several meetings held. A special meeting was held to which all parents were invited with the object of interesting them in the movement; the Acting Director of Agriculture attended and addressed them on the whole scheme emphasising the part to be taken by parents and that the work undertaken must be successful.

82. A site was selected for the garden which was ploughed, fenced and drained, and an inlet pipe from the middle-walk canal laid down for irrigation purposes.

83. The whole area was planted in black eye peas; these were reaped in September and early October. The following seeds were purchased from the East Demerara Station vote and given to start a nursery prior to the removal of the black eye peas.

Unfortunately, very little attention was given to watering these seedlings, and in consequence very few survived :

Landreth's Globe Tomato ...	...	6 packets.
„ Big Boston Lettuce...	...	4 „
„ Simpson Lettuce ...	...	3 „
„ Ox-Heart Carrot ...	...	3 „
„ French Breakfast Radish	...	1 packet.
Sutton's Long White Radish ...	...	2 packets.
„ Earliest Cabbage ...	...	2 „
„ All Heart Cabbage ...	...	2 „

3,000 onion seedlings were also supplied and seedlings of six varieties of tomatoes.

84. The following tools were supplied free :—

3 Agricultural Forks, 3 Hoes, 1 Shovel, 4-18 in. Cutlasses, 2-1½ gallons watering cans, 7 Hand Forks, 3 Hand Trowels.

85. The Agricultural Instructor of the District gives instructions twice weekly. Great difficulty has been experienced in getting the boys to water the seedlings and to attend when the Agricultural Instructor is absent. The majority of teachers take very little interest in agriculture and the committee has also apparently lost interest, and it will be some time before the garden can be brought into proper working order. Efforts of this kind are a waste of time unless and until it is recognised that school garden work is to form part of the school curriculum and is properly supervised by the Head Teacher with the advice of the Agricultural Officer

SUB-STATION CECILIA.

86. *Soya Beans*.—A plot measuring 3,902 square feet was planted with Soya Beans on December 17, 1930, at a distance of 18 ins. x 4 ins. The yield from this area was 188 lbs. or 2,098 lbs. per acre. On November 4, 1931, an area of 3,530 square feet was planted. The plants have made good growth and are now fruiting.

87. *Tomatoes*.—Seeds of Crimson Cushion were sown on November 8, 1930, and an area of 1,766 square feet planted out on December 17. The plants began fruiting in February, 1931, and continued until May. The yield obtained from this plot was 470 lbs. or 11,593 lbs. per acre. Most of the fruit was distributed to farmers for seed purposes; besides this 900 seedlings were grown from seed-beds collected and distributed free.

88. *Pineapples*.—These are not doing as well as was expected. The Red Spanish has died out. Weather conditions were much against these plants.

89. *Crowa*.—A small number of plants was received from the North West Station, and was planted out on November 11, 1931.

90. *Legumes*.—Large quantities of seed of Bengal Bean, Canavalia, Dwarf Bonavist and Lima Bean have been distributed.

91. *Onions*.—Over 30,000 seedlings were grown and distributed to farmers free during the year. Small lots of seed purchased by farmers were also grown and the seedlings handed to them.

92. *Sweet Potatoes*.—Plots of the following varieties have been planted for observation :—

Local—Strongman, Garden, Milton.

Imported—Black Sam, Red Nut, Black Rock, Carolina Lea, Six Weeks, St. Vincent, Brook's Gem and Philippine.

93. The number of persons who visited this station during the year was 624.

94. The Station is serving a most useful purpose as a seed supply centre.

DISTRICT WORK.

95. *Pure line padi distribution scheme.*—Funds for the assistance of the rice industry has been provided from the Colonial Development Fund, namely, a free grant for the erection of padi barns and a loan repayable at the end of 5 years for the purchase and distribution of selected seed. This scheme has, briefly, for its object the extension of pure line varieties throughout the Colony through the medium of 10-acre blocks and private seed farms. During the year under review a 10-acre block of pure line Demerara Creole was established at Pln. Nonpareil for the purpose of supplying seed to selected farmers in the East Coast District. Twenty farmers have taken blocks of half an acre each, seed being distributed free from the Georgetown Station. At Pln. Hope the entire estate has been put under pure line Demerara Creole, approximately 900 acres being established. Three ploughings were given and roguing done where necessary. By this means the standard of purity of the seed was raised to almost the level of the Department's seed.

96. *Padi barns.*—To enable the scheme outlined above to be efficiently carried out, seed purchased through the Revolving Fund is stored in padi barns (erected through funds from the Colonial Development Fund) and distributed the following season to approved farmers. Two such barns have been erected in East Demerara; one at Golden Grove for the storage and supply of seed on the Upper East Coast, and the other at the Experiment Station, Georgetown, the existing barn there being renovated for the purpose.

97. *Co-operative Work.*—There are seven Co-operative Credit Banks in East Demerara, three are under my Chairmanship and the remaining four under the Senior Agricultural Instructor (Mr. C. C. Dowding). Monthly meetings have been held. Efforts are being made to collect all outstanding loans but this will necessarily be slow.

98. *Cane-farming.*—An effort has been made to establish cane-farming in blocks, thereby facilitating reaping and flooding. There is every indication of the area under sugar-cane being considerably increased. In collaboration with the Cane Agronomist, a preliminary enquiry was made into the cane-farming industry of the Colony. This necessitated several meetings with cane-farmers, and considerable work was entailed in collecting and tabulating data obtained from sugar estates. A report on the findings was submitted.

99. *Other Work.*—In addition to the establishment of School Gardens (special surveys of all the schools being undertaken for the purpose) and inauguration of competitions, etc., as referred to in preceding paragraphs, special attention has been paid to a survey of the village lands, and a preliminary report on the conditions of the East Coast villages was submitted.

100. The collection of the agricultural census has also taken up a great deal of time, but the bulk of the data was collected during visits to the various small holdings during the year, the results being tabulated at the close of the period under review. This, however, did not apply to the holdings on the creeks where great difficulty was experienced in the collection of reliable data and, eventually, special visits had to be made; plans of these creek areas were obtained from the Lands and Mines Department in order to facilitate the procuring of reliable figures.

101. Efforts have also been made to interest village farmers in flood-fallowing of other crops than sugar-cane, but so far with no success. This should be feasible as soon as farmers realise the importance of growing crops in the block system.

102. Special visits were made to all the rice mills in the district in connection with an investigation into conditions affecting rice cultivation and manufacture, and a tabulated report was submitted. Some of the major points investigated were:—irrigation and drainage especially in relation to efficient control, damage caused by floods or drought and rainfall; land tenure; cultivation methods such as

harrowing, puddling, levelling, etc., types of implements in general use and costs of handling; credit facilities; use and supply of manures; diseases and pests; milling and storage.

GENERAL REMARKS.

103. Particular emphasis has been laid on the fact that on the Lower East Coast existing conditions only justify farmers cultivating, on a large scale, sugar-cane and rice, and such ground provisions as are necessary for their own consumption. Drainage facilities preclude the cultivation of any permanent crops except in certain small, well-drained areas. The villages are, on the whole, suffering from poor drainage caused by badly graded and too narrow side-lines. This is further accentuated by the enormous waste of water by the majority of rice farmers; proper control would result in a saving in Village Administration (*viz.*, pumping costs).

104. Considerable improvement has taken place in the control of *Brassolis* infestation of coconuts. Most estates not only keep an observation gang but have established parasite breeding stations. It is regrettable that one large estate and most of the small cultivators will not assist in this direction.

MISCELLANEOUS.

105. *Reports.*—The following have been submitted to the Director during the year:—

Joint report on the preliminary enquiry into the cane-farming industry.

Report on the conditions of the East Coast Villages.

Report on padi cultivations in East Demerara.

Report on agricultural competitions.

Monthly progress reports on Lodge Village Allotments.

Monthly progress reports on East Demerara Station.

Reports on co-operative credit banks.

106. In conclusion, I should like to express my appreciation of the loyal assistance rendered by the staff during the year, and to Managers and personnel of sugar and other estates for many courtesies.

E. M. PETERKIN,
Agricultural Superintendent,
East Demerara.

January 14, 1932.

DEPARTMENT OF AGRICULTURE.

REPORT OF THE WEST DEMERARA DIVISION FOR THE
YEAR 1931.

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REPORT OF THE WEST DEMERARA DIVISION FOR THE YEAR 1931.

STAFF.

J. D. Gillespie, B.Sc. Agric. (Edin.)—Agricultural Superintendent.

GENERAL.

I was temporarily transferred from February to August, 1931, to the North West District during the absence of Mr. Beckett, Agricultural Superintendent, on leave.

2. The same agricultural policy as last year has been continued ; and extensive tours have been made throughout the whole of the district which includes the Island of Leguan. Full particulars of the various experiments carried out during the year are given under the various crop headings whilst Agricultural Education and Co-operative work, etc., are also dealt with separately. Paddy farmers in the past who considered it a luxury to grow pure seed are now realising the benefits to be derived from growing selected seed paddy as, in addition to increased yields, higher prices are obtained when the paddy is carefully milled.

3. The establishment of private seed farms for paddy has received particular attention and it is pleasing to be able to report that an increased number has been established in the district during the year. The number of enquiries and correspondence is gradually on the increase and the need of an office typewriter and telephone is badly felt. The former is especially necessary to assist in the collection and the collation of the agricultural census data.

SUGAR.

4. *Sugar Cane Experiments.*—The three sugar experiments which were carried out in 1930, in conjunction with the Cane Agronomist, in West Demerara were continued this year and another two laid down. The trials at Field No. 14E. and Field No. 1W. at Plantation Uitvlugt were reaped, the results of the former being presented in the Agricultural Journal of British Guiana, Vol. IV., No. 1., and of the latter in the Agricultural Journal of British Guiana, Vol. IV., No. 4.

RICE.

5. Special efforts have been made to extend the growing of pure line Demerara Creole padi. The price of rice on the West Coast, Demerara, is still lower than in the Essequibo District or in East Demerara, due entirely to the poor quality and the mixed types produced. The spasmodic efforts that have been made in the past by the distribution of pure seed have not assisted materially in any large quantity being grown and even of that which has been grown, a percentage was milled and not kept for seed purposes. The line of action now adopted, however, has been to demonstrate the value of pure line padi in as many centres as possible. Further, arrangements have been made for the growing of padi in two demonstration blocks of 5 acres each and the seed will be purchased and stored for eventual distribution, next season, to approved farmers. This has been made possible through funds provided from the Colonial Development Fund for the assistance of the rice industry of the Colony.

6. Two disused cells of Fellowship Police Station were renovated early in October and are being used as a padi seed store. It is fairly central and orders have been already booked. During the year approximately 334 acres of Demerara Creole and 12 acres of Blue Stick padi were grown in the district ; the farmers since they failed to carry out roguing and general instructions, were not given "pure seed certificates."

COFFEE.

7. The limiting factor in the extension and development of the coffee industry in this district is the wholesale price obtainable for the coffee beans. Low prices again prevailed but there was an upward tendency at the close of the year. Despite the ravages from fire during the dry season, bad drainage and consequently water-logged roots during the wet season, a number of farmers are still maintaining, in fair order, their coffee farms. Two or three typical blocks or grants of coffee are being secured for demonstration purposes—improved cultural methods, pruning, replacing of uneconomical trees, etc.

8. The methods adopted for curing and preparation for market, leave much to be desired as immature, over-ripe and mixed types are cured and retailed together.

CACAO.

9. The cultivation of this crop does not receive the attention from farmers that it deserves and consequently only poor returns are obtained. Visits have been made and instructions given in regard to pruning, shade, drainage and pest control.

10. Most of the trees and holdings are attacked with Witch Broom Disease and are in a sad state of neglect. This crop is worthy of more attention in spite of the low prices prevailing in the world's markets for cocoa and would still pay for labour and expenditure on it. It is hoped, however, to obtain one or two blocks and demonstrate proper cultural methods for the benefit of those concerned.

TOBACCO.

11. As an auxiliary crop to coffee for the Canals Polder, arrangements were made last June for the establishment of five half-acre blocks for tobacco cultivation. Considerable difficulty was experienced at the commencement (during the nursery stages) in establishing the seedlings owing to the dry weather and the scarcity of irrigation water. Tobacco cultivation needs intensive cultivation if it is to be successful and this fact alone was clearly demonstrated to those farmers who participated. Regular attention is absolutely necessary if the cultivation is to be successful not only at the early stages of growth but throughout the whole period of cultivation. It is for this reason that its cultivation is not particularly popular and as an indication of this the following example is given. Twenty square rods of land were grown to anything near completion with tobacco and before the crop was harvested altogether 15 men (farmers and labourers) were employed on the five plots each in turn leaving the work to search for an easier job.

12. The most successful germination was obtained at Plantation Middlesex, No. 2 Canal, and from that nursery plants were carried in my car to other centres for planting purposes. Supplies were also obtained from the Experimental Station at Georgetown.

13. Some of the most progressive farmers applied for and received seed for planting purposes. At the same time that the seed was distributed detailed instructions were given on the preparation of the seed bed, watering, shade, and other matters pertaining to the successful cultivation of this crop. I have emphasised to the farmers in the district the great benefit that may accrue from the successful cultivation of this crop, i.e., the possibility of developing the local market for cigarette and black fat tobacco.

PINEAPPLES.

14. During the year the investigation of pineapple growing on the riparian lands of the Demerara River was continued. A concession of land was obtained by the New Pineapple Company on the West Bank, Demerara River, and operations were begun about mid-year. A visit was paid to the area in November and a report submitted. Proposals have been made to lay down experiments with the various artificial manures next year if the Company so desires and approves.

AGRICULTURAL EDUCATION.

15. Lectures have been given at the various Co-operative meetings held from time to time and questions are encouraged on all matters relating to agriculture. I find these societies very useful for such work and also for the distribution of leaflets, etc.

16. Towards the end of the year a Boys' and Girls' Club on a small scale was started at Den Amstel and Fellowship. A suitable piece of land has been obtained and a small committee of management formed. The pupils are showing great interest and the Club gives every indication of being successful. The area has already been forked and the land properly drained and fenced. The pupils will be drawn principally from the two schools in the neighbourhood. It is hoped to commence actual garden work as soon as school re-opens.

17. I find that the best propaganda, and that which is more appreciated, can be accomplished by "short talks" and inspections when on circuit rather than lectures to the villagers. It is in this way that information is circulated amongst those who are interested in more up-to-date methods of agriculture.

Co-operative Work.

18. Regular monthly meetings of the six Co-operative Credit Banks of which I am Chairman have been held. As each Bank has its own Committee of Management, the work at the general monthly meeting devolves on the issuing of loans and the examination of the financial statement, together with any short discussions on agricultural questions generally. Particular attention has been paid to the collection of old outstanding loans and this involved, in many instances, the taking of action through Law Courts, which is not only regrettable but harmful to the true co-operative spirit. It also hinders my agricultural work in some instances. Four of the banks are doing fairly good work but in the other two interest is lagging. The reason for this is chiefly on account of the determination of the Committee to collect all overdue loans before making new ones.

19. There is one point which I particularly wish to emphasise and that is the unnecessary trouble that borrowers have to undergo before a loan can be issued from the various Co-operative Credit Banks. As is generally known, promissory notes are received in exchange for such loans, and in consequence, a signature has to be attested and the loan paid to the borrower in the presence of a Justice of the Peace when the borrower cannot write. One bank, *i.e.*, Good Intent and Sisters, is two miles distant from the nearest resident J.P. and should he be absent from his home, it means that the borrower and the Chairman, who always pay loans personally, are put to considerable inconvenience. It should be pointed out that the previous Chairmen of the banks were Justices of the Peace and it is only hoped that, in future, the same policy will be adopted for the present Chairmen.

Competitions.

20. Owing to my transfer to the North West District the farmers did not appreciate the value of the competitions which had been arranged previous to my departure. These competitions were as follows:—

- (1) Rice competition—for growers of not less than half an acre of padi in extent.
- (2) Ground provision competition—for the best miscellaneous farm in the Canals Polder.

21. For the rice competition, 26 entries were received but it was not possible to award any prizes, as not only had the rules been disregarded but, in some instances, pure line seed had not been sown. Those who had procured pure line seed obtained good yields but more attention was necessary to drainage and irrigation and to the roguing out of volunteer types, which were very much in evidence in some plots. High prices can never be obtained for such quality padi.

22. In spite of the Canals Polder supplying ground provisions to the Georgetown market no real serious effort was made to participate in the ground provision competition and consequently no prizes were awarded.

MISCELLANEOUS.

23. Every opportunity, which arises, is taken of visiting parts of the district which do not usually fall under the scope of actual routine work. Further, during the year a visit was paid to the East Coast, Demerara, in company with the Agricultural Superintendent of that District, to the 900 acre block of pure line Demerara Creole paddy growing at Plantation Hope. In the month of November a visit was paid to the Berbice District, where the opportunity was taken of inspecting some of the pure line seed farms, in addition to the two paddy barns, a Co-operative Credit Bank, various experiments on sugar estates and other demonstration work on the Berbice District as far as Village No. 63.

24. *Reports.*—The following are the most important major reports submitted to the Director during the year :—

General Agricultural position in the North West District.

Present state of work at the Hosororo Experiment Station.

Contemplated experiments at Hosororo Station.

Monthly progress reports North West District. (7)

Monthly progress reports West Demerara. (5)

Monthly reports on co-operative credit banks.

Progress reports on the tobacco demonstration trials in the Canals Polder.

Report on a visit to the New Pineapple Company's concession on the Demerara River.

Contemplated experiments in West Demerara during 1932.

The first four reports were submitted whilst acting Agricultural Superintendent of the North West District and the remainder since resuming duty in West Demerara.

JAMES D. GILLESPIE,
Agricultural Superintendent,
West Demerara.

January 14, 1932.

DEPARTMENT OF AGRICULTURE.

REPORT OF THE ESSEQUIBO DIVISION FOR THE YEAR 1931.

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REPORT OF THE ESSEQUIBO DIVISION FOR THE YEAR 1931.

STAFF.

A. deK. Frampton, C.D.A.—Agricultural Superintendent.
A. A. Abraham —Assistant Superintendent.
J. E. Wilson —Assistant Agricultural Instructor, Wakenaam.

GENERAL.

The chief work during the year has been in connection with Bush Lot Land Settlement and the Anna Regina Estates, but, in addition to this, extensive tours have been undertaken throughout the District including Wakenaam. A special campaign for the introduction of pure line seed padi during the planting of the Autumn crop was carried out. Private seed farms and demonstration plots were laid down at all padi centres in the district from which supplies of pure line seed will be obtainable in the future.

2. Due to a drought in the early part of the year and the lack of irrigation water, many farmers did not attempt to plant the padi spring crop. The pure seed obtained from the previous crop, however, was kept and used for the May-June sowing.

3. The autumn padi crop was an excellent one, and it is particularly pleasing to be able to report the excellent yields obtained from the pure line demonstration plots, with the exception of a few plots in Wakenaam, which suffered from poor irrigation and an attack of the padi Stem-Borer.

4. The attacks of Viciissi ducks were more persistent than in 1930 and caused enormous damage to the nurseries, resulting in replanting as many as three times at some centres before seedlings could be obtained. It also delayed planting in the field by two or three weeks.

5. All the best padi from the Anna Regina Estates and the Bush Lot Settlement was purchased on behalf of a Georgetown firm—the total number of bags purchased being 6,509.

6. Greater interest has been evinced by farmers throughout the district in mixed farm cultivations and a considerable increase in the area under minor crops, more especially plantains, has taken place. A list of the growers with a census of the crops grown and the anticipated yields have been forwarded to the British Guiana Producers' Association.

RICE.

7. *Agricultural Experiments—Henrietta Experimental Station.*—The Experiments with rice at the Henrietta Experiment Station were continued during the year. Owing to the lack of irrigation water it was decided to conduct the padi experiments with the autumn crop only, and a variety test with the best local varieties and a manurial test with six different manures and treatments were laid down.

8. (a) *Variety Experiment.*—The following varieties were tested in three latin squares, each square containing 36 plots of 1/80th. of an acre each :—

H. 7 ; 79 ; 76 ; 75 ; Demerara Creole and Blue Stick.

9. The nurseries were set during May-June and planting in the field was carried out in July. With the exception of the damage done by ducks during the early stages of growth an average season was experienced with no abnormal conditions.

Harvesting commenced on November 13, and the returns obtained quoted in bags of padi (140 lbs. per bag per acre) were as follows:—

	No. 79.	Blue Stick.	H. 7.	No. 76.	Demerara Creole.	No. 75.	Mean.	Standard error of Mean.
Percentage of mean ...	35.88	33.96	32.76	32.56	31.23	28.93	32.55	0.70
Bags padi per acre ...	110.2	104.3	100.6	100.00	95.9	88.9	100.0	2.15
1930 yields in bags padi per acre.	29.1	26.9	26.6	26.0	27.2	27.5	...	...

10. The results of these experiments, which were submitted to the Chemist-Ecologist for statistical analysis, indicate that there is no significant difference in yield between No. 79 and Blue Stick, but that No. 79 is superior to other varieties. The fact that No. 79 was first in order of merit in the 1930 experiment would appear to warrant extension of this variety on a field scale. It is therefore intended to increase the area under this variety at the Henrietta Experimental Station in 1932. The suitability of this variety under field conditions will then be further observed and if it still proves a success will be multiplied for general distribution, should its commercial qualities justify it.

11. The yields of the three latin squares in bags padi per acre and as a percentage of the general mean are given below:—

	A.	B.	C.	Standard error of Mean.
Bags per acre ...	31.15	34.07	32.43	0.49
Percentage ...	95.7	104.70	99.60	1.51

12. (b) *Manurial Experiment*.—This experiment was laid down with the idea of testing the effect of manures on padi, and also to indicate whether or not economic increases in yield would result from their application.

The treatments consisted of:—

- Control.
- Ground limestone—1 ton per acre.
- Superphosphate of lime—240 lbs. per acre.
- Sulphate of ammonia—160 lbs. per acre.
- Sulphate of potash—80 lbs. per acre.
- Organic material—1 ton per acre.

The applications were made singly and in every possible combination.

13. Each plot was laid out as a self-contained unit with its own irrigation and drainage. Great care was taken that the drainage water from any one plot did not enter any of the adjoining plots. This necessitated the deepening of the main drainage trench well below the level of the plots. Very stormy weather prevailed during the latter part of October and the padi became badly laid and made harvesting conditions difficult. It also affected the yields slightly as some of the "riper" padi shed its grain and a quantity of the padi beaten down began to germinate. The statistical analysis of the results showed that the manures had had no effect on the yield of padi or the weight of straw. This may be attributed to the fact that the experiments were conducted on fairly new land; next year these trials will be carried out on typical padi soils of the district where beneficial applications of artificial manures will have the greatest effect.

14. *District Work*.—The 207 bags of pure line seed padi which were reaped from the multiplication plots in 1930 and were not used for the first crop, were stored for distribution and disposed of for the autumn crop of 1931. Of this quantity 76 bags were distributed on the Essequibo Coast to 160 farmers in 30 different padi growing centres. From this seed 156 acres were eventually planted and although the area was small, compared with the number of bags of seed issued,

it must be borne in mind that the nurseries had to be reset on two or three occasions on account of the damage inflicted by wild ducks, flooding and caterpillars. On Wakenaam Island 131 bags were distributed and this planted 310 acres. This seed was distributed through seven different centres to 75 farmers and these farmers, in many instances, again divided up the seed purchased to other farmers, until eventually the number growing pure seed exceeded 100 in different parts of the island. The variety used for distribution was pure line Blue Stick.

15. Because of the success obtained from the pure line seed previously distributed and from the publicity and instructions given, it was found that seed padi on hand was insufficient to meet the farmers' requirements. It was, therefore, decided to adopt a scheme for padi distribution through certain centres whereby small demonstration blocks could be established and from which the future seed supplies of the district could be obtained.

16. This plan has enabled the establishment of private seed farms throughout the district. Their functions are to act as multiplication centres for distribution to farmers, the Department of Agriculture maintaining pure supplies to each centre.

17. Early in the season a circular was distributed to all estate proprietors on the Essequibo Coast and to farmers in Wakenaam, pointing out that it was impossible to meet their total requirements for supplies of pure line seed as the area at the Government Experiment Station at Henrietta was limited. All estates on the coast were visited and the situation explained. As anticipated the demand exceeded the available supply by a considerable amount. Large orders were also received from the farmers in Wakenaam Island, through the Agricultural Instructor who had been carrying on propaganda work since the beginning of the year.

18. Working on the assumption that $2\frac{1}{2}$ -3 acres could be planted from one bag of seed padi, a scale of distribution was then drawn up. The amount of seed needed by each estate to plant every acre with pure line strain was worked out. The system was as follows:—Taking an estate of 240 acres it was seen that 80 bags of pure line seed would be necessary to plant up this area. Taking a medium yield, 5 acres would produce the amount of seed. Therefore, an estate having 240 acres was supplied with the requisite seed to plant an area which would produce 80 bags.

19. In a circular distributed to estate proprietors the importance of this scheme was stressed. They were asked to distribute the pure line seed to their best cultivators only, in not less than one-acre blocks—but this was later altered to not less than half-acre blocks. It was impressed on them that on no account must padi from their "seed farms" be milled into rice, as that would lead them nowhere.

20. Every estate proprietor agreed to co-operate with this scheme. As soon as seed distribution commenced the Agricultural Officers visited the estates. Cultivators were interviewed and advised as to the best method of treating the seed prior to sowing and also in the preparation in the nurseries. One or two complaints were received regarding the germination of the seed padi, but this was found to be due to incorrect seed treatment prior to sowing in the nursery. Another circular was then sent out to all estates and to the farmers in Wakenaam describing the proper treatment of seed for sowing. This matter was also fully discussed with farmers, and after this no further complaints were received. A book was then sent to each estate proprietor in which to record all cultural operations, observations of disease or insect pests, visits of inspection and instruction given, and eventual yield obtained on each private seed farm. Thus a complete record of all private seed farms is being kept.

21. It was impressed on estate proprietors that these methods should be adopted for each crop, fresh supplies for the farms being obtained from the Henrietta Station. In this way a standard of purity can be maintained and on signs of

deterioration of padi through neglect of roguing fresh pure line seed can be distributed to all cultivators from the private seed farms.

22. Working on this plan it was anticipated that, at the end of the crop, the estates should have enough pure line seed padi to distribute to every tenant. Losses occurred on some estates through damage by wild ducks and caterpillars, but this deficit can be made up by purchasing fresh seed from Henrietta or from private seed farms in Wakenaam, where in the latter case, approximately 350 acres are under pure line seed padi.

23. The quality of the ordinary padi on the island was extraordinarily bad and it is hoped to obtain and reserve enough pure line seed from the autumn crop of 1931 to distribute to every padi farmer on the Island including Hog Island. Thus, working on the foregoing plan, a very large area of pure line Blue Stick padi will be established from a comparatively small initial stock.

24. The working of this plan, the distribution of seed and visits of inspection have been the main work carried out in the Essequibo District during the last 4½ months. Visits of inspection and instructions will be carried on until the completion of harvest. It may be noted here that one estate only purchased one bag of seed padi. The proprietor of this estate has already built up a seed supply for his tenants from pure line Blue Stick padi obtained from Henrietta last year. This proprietor was also selling specially selected seed padi of excellent quality, prior to the planting of the present crop.

25. *Padi Barns.*—A padi barn has been erected at Anna Regina from funds supplied by the Colonial Development Fund. Padi reaped from the Henrietta Station and also that purchased through private seed farms will be stored here until required for the next planting season. In Wakenaam Island a building has been acquired at Sans Souci for padi seed storage; 305 bags being purchased and stored for future pure line seed requirements in that island.

26. Bookings for seed padi for the spring crop have not been large, the farmers and estate proprietors retaining the seed grown by them during the 1931 crops, an indication that serious attempts are being made to carry out previous instructions.

27. *Rice Grading.*—Rice grading was commenced in the district during the month of July. With the inauguration of the grading of rice on the Coast, considerable savings can be effected by the miller-exporter who, shipping direct by sea-punt from the factory to the outgoing steamer, reduces handling charges.

28. The following table shows the total number of bags graded, and destination of shipments:

GRADE.		NO. OF BAGS.	DESTINATION.
W. G. Super	...	1,075	Trinidad.
Super ...	...	11,192	Trinidad and Barbados.
No. 1 ...	...	310	Trinidad.
Broken	...	75	Trinidad and Barbados.
Total No. of Bags	...	12,652	

OTHER CROPS.

29. *Sweet Potato Trials.*—The collection of sweet potato cuttings made last year was extended and additional supplies obtained for distribution purposes. The following varieties have been established:

Pink Stem, White Stem, Strongman, Choke Throat, Turkey Claw, Euclip, Garden Cuttings and Milton.

The following have also been received from Barbados for trial: Red Nut, Black Sam, Philippine, Brook's Gem, St. Vincent, Six Weeks, Black Rock, Carolina Leu, Trinidadian.

30. The farmers are being encouraged to take up the cultivation of this crop on a large scale as there is always a market at fair prices. In addition, some of the lighter soils are well suited to the growing of this crop and some excellent yields have been obtained.

ANNA REGINA ESTATES.

31. The management of these estates which includes Henrietta and Richmond was continued during the year. La Belle Alliance Estate was also placed under my control during the month of July. On the whole, the estate tenants have suffered very severely from the effects of the drought as only one crop of padi has been reaped, namely the autumn crop of 1931.

32. All the padi land on the estates have been re-allocated which has enabled the farmers to obtain their respective holdings in one block. Previously, the farmers' holdings were scattered in various sections of the estate but the new arrangement will allow of the work being more economically carried out. The total acreage of padi land cultivated on these estates during the last autumn crop was 828 acres as follows:—

Anna Regina	...	...	204 acres.
Henrietta	...	...	75 "
Richmond	...	...	150 "
La Belle Alliance	...	...	156 "
Bush Lot	...	...	243 "

33. During the year, a large area of land exceeding 100 acres was taken up by tenants for provision cultivation. The crops planted on this land will come into bearing early in 1932. Special attention has been paid to the irrigation and drainage system and the Richmond Control Sluice has been completely rebuilt. The effect of this will be to give the estates another channel whereby extra water can be obtained from the conservancy, which will be very beneficial during dry weather, especially as the acreage under padi cultivation is being gradually increased. In fact it is noteworthy that both padi and ground provision cultivation on these estates have considerably increased during the period under review.

34. The usual works appertaining to estate management have been carried out, i.e., the collection of revenue for padi and provision lands, cattle pasturage fees and house rents. Alterations have been made to the old sugar factory by the Public Works Department and accommodation provided for the housing of the new rice mill recently imported from Great Britain, provided from the Colonial Development Fund.

Unemployment Relief Works.

35. A scheme for the development of uncultivated lands on these estates was approved by His Excellency the Governor in July with money provided from Unemployment Relief Funds. Work was commenced on this scheme during the last week in July and conducted under my control up to the end of November, since when control has been taken over by the Public Works Department.

36. On an average 500 persons have been employed weekly in breaking down areas for padi cultivation, clearing bush on the high lands for provision cultivation re-conditioning and underbushing new acreages for cattle pasture, carrying out improvements and extension of drainage and irrigation works, digging trenches, levelling, etc. This work, as may be expected, entailed a considerable amount of

supervision, especially in respect of the breaking down of the land for padi cultivation. Up to the date of handing over to the District Engineer the following had been completed :—

170 beds had been levelled for padi cultivation.

200 acres underbushed for provision cultivation.

200 acres re-conditioned, underbushed and wired in for cattle pasture.

37. The drainage and irrigation system of Anna Regina and Henrietta Estates was extended and improved. This scheme when completed, will enable the whole of the available lands to be taken up for cultivation. It will also make available large areas of land for farmers in the district who at present have holdings which are too small to support them. In fact, the number of applications for lands already received greatly exceed the total acreage which will be available on the completion of this scheme.

COMPETITIONS.

38. The following agricultural competitions were held in the Essequibo District during 1931 :—

Essequibo Coast—Padi Competition.—

For the best block of transplanted pure line seed padi (Autumn crop) on the Essequibo Coast. The area to be not less than half an acre.

Wakenaam Island—Padi Competition.—

For the best block of transplanted pure line seed padi (Autumn crop) on Wakenaam Island. The area to be not less than half an acre.

Essequibo Coast—Provision Competition.—

For the best miscellaneous farm from Affiance to Richmond. The area to be not less than $\frac{1}{4}$ of an acre.

Bush Lot Land Settlement—Padi Competition.—

For the best block of padi grown by a settler at Bush Lot.

Bush Lot Land Settlement—Garden Competition.—

For the best miscellaneous garden cultivated by a settler at Bush Lot.

Points were awarded as follows :—

(a) For the padi competitions, Essequibo Coast and Wakenaam Island :—		
General layout and preparation of nurseries and beds	...	30 points
Uniformity of type and freedom from red grain	...	20 "
Freedom from weeds, pests and diseases	...	10 "
Yield	...	40 "
(b) For Miscellaneous Farm Competition, Essequibo Coast :—		
Drainage	...	30 "
General layout and state of cultivation	...	30 "
Condition of crops and freedom from pests and diseases	...	20 "
Livestock (including poultry)	...	20 "

39. *Padi Competition—Essequibo Coast.*—Wide publicity was given to this competition to all farmers throughout the District who were growing pure line padi purchased from the seed station at Henrietta. The competition was well supported and the total number of competitions was 70. Entries were received from all parts of the Coast, Supenaam to Devonshire Castle, and it is gratifying to note the considerable increase over last year. Of the total number of competitors, 14 withdrew owing to the dispute between millers and farmers during the early part of the harvest. Great interest and keenness was displayed by competitors, particularly those in the Aurora area, where padi cultivation is on the increase and pure line seed padi not so well known.

40. Farmers generally were greatly impressed by the sample of padi reaped from the competition plots, which was very even and free from any mixed type of seed. The yields were in excess of those from the old type seed and this fact, together with the superior appearance of the pure line, made farmers all the keener.

41. All plots were inspected regularly from the time the seed was issued up to the time of reaping. Special instructions were given regarding the size, preparation of the nursery and sowing of seed, etc. Also, it was impressed on all farmers that to obtain strong plants the seed in the nursery must not be sown too thickly, *i.e.*, not more than 8 lbs. of seed per square rod; the seed to be sprouted before setting.

42. The usual practice adopted for germination is to flood the nursery, shy the seed, and let the water remain for one or two days. It was pointed out that this method often rotted much of the seed and was wasteful. The system advised was, soaking the seed (in not more than 50 or 60 lb. lots) for 12 hours and then when thoroughly soaked, removing from the water and placing under heaps of straw. The seed is then left and when germination is complete, the sprouted seed is sown on to a well puddled nursery.

43. Demonstrations were given in such methods and special circulars were distributed describing these operations, which were well carried out by all competitors. The vigour of the seedlings at planting time was due to the fact that ample space was allowed in the nursery and was remarked upon by all farmers.

44. During the growing period, instructions were given on weeding and the removal of volunteer plants, later, when the padi was coming into ear, practical demonstrations were given in "roguing" undesirable types such as red grain and mixed padi. Demonstrations were also given of the single head method of seed selection. This is seldom carried out by farmers, however, who do not fully realise its importance as yet.

45. This year's competitions have more than ever brought home to farmers the benefits to be derived from planting pure line seed. It is specially gratifying to note that all the larger estates have harvested sufficient seed to make a complete planting of their entire areas next year.

The final results were as follows :—

- 1st prize (\$25)—Badge, Plantation Aurora.
- 2nd „ (\$15)—Taljeet, Pln. Spring Garden.
- 3rd „ (\$10)—Alvoium, Devonshire Castle.

The highest yield obtained was from Badge's entry—34 bags—(1 bag-155 lbs gross).

46. *Padi Competition—Wakenaam Island.*—The competition on this island was very well supported, though the entries were not as many as anticipated. General publicity had been given to the competition since its inception by placards, pamphlets, etc., and by the Agricultural Instructor on his tours around the island. The necessary instructions and demonstrations were given as in the case of the competitions on the Coast and the same circulars distributed to farmers. Instructions were generally well carried out, not only by the competitors but by other farmers as well.

47. The total number of entries eventually received was 23, although at the time when seed was being distributed practically every padi farmer made an application for a small supply. All applications could not be fulfilled, however, as the supply was insufficient. The conditions were the same as in the Essequibo Coast competition. The limiting factor as regards entries was the fact that all competition padi had to be hand threshed. Bull mashing is the practice of the island and it is difficult to get the farmers to drop this practice. They maintain that a small price only is paid for their padi and that the labour charges do not allow a profit when

the padi is hand beaten. Padi is always cheaper on the island than on the Coast. There are no miller proprietors and hitherto the sample of padi from Wakenaam has been very poor, being a mixture of all types.

48. The pure line seed plots gave yields in excess of the old type seed in every case and farmers were greatly impressed with the sample of padi reaped. The results obtained have become well known among all cultivators. Pure line seed is badly needed in Wakenaam and it is fortunate that money was available to purchase supplies of seed from competitors to store for the next planting season. Thus, 305 bags of pure line seed have been purchased and stored for future distribution, much of which has already been booked by farmers, profiting from the experience gained by the demonstrations.

The result of the competition was as follows :—

- 1st prize (\$25)—A. Persaud, Noitgedacht.
- 2nd „ (\$15)—Kenath, San Souci.
- 3rd „ (\$10)—Ali Husen Khan, Maria's Pleasure.

49. *Bush Lot Settlement Padi Competition.*—The conditions of entry for this competition were as follows :—

- (a) Entrant to be a settler under the Bush Lot Land Settlement Scheme.
- (b) Entrant to be cultivating the whole of his padi lot, i.e., three acres.
- (c) Entrant to have his nurseries set by the end of May.

50. All the settlers entered for this competition. It was gratifying to note that following on instructions given during the competition held last year, all the settlers including the new farmers, prepared large nurseries leaving plenty of space for the seed when sown, which would produce strong plants. There is still a tendency, however, to sow more seed than is necessary. It was emphasised that this is a wasteful practice and that if plenty of space is given in the nursery stronger plants and better yields will be the result. The seed was sown at the rate of 7 to 8 lbs. per square rod. All seed germinated prior to sowing according to the instructions. The nursery plants were set in good time and made a promising start despite the lateness of the rains and the consequent lack of irrigation water.

51. Unfortunately, due to the persistent attacks of Vicissi ducks, a bad set-back occurred. These came from the Tapacooma Savannahs with the commencement of the heavy rains. Nurseries were completely wiped out by these birds and acres of seedlings lost. Everything was done to combat this pest. Shelters were erected by the farmers who sat up all night to protect their nurseries. Scares, traps and guns were used but with little result. Nurseries had to be resown in many cases as many as three times. It was estimated that on the Bush Lot Land Settlement section alone, \$60 worth of damage was done in one night. The birds later attacked the grown plants laying nurseries quite flat.

52. It was found that the most successful way of keeping the ducks off newly set nurseries was to dry them off as completely as possible every night. Water in the nursery attracted the birds and as they came in flocks they were able to clean up a set of nurseries very quickly.

53. The great losses sustained through the ravages of this pest also caused transplanting to be delayed by at least two weeks. Heavy rain continued, and the ducks gradually migrated elsewhere. Later a bad attack of caterpillars broke out. These also did much damage. Nurseries were flooded as high as possible and the plants “brushed” to remove the pest.

54. Such two serious set-backs did not encourage the cultivators, who at that time were inclined to give up all idea of any competition as long as they were able to

get their padi lots planted. Planting was eventually completed by the second and third weeks in July, three weeks later than anticipated. Instructions were then given in the matter of roguing, *i.e.*, elimination of all volunteer plants. This was well carried out on the whole with the first and second weedings. Here again it was gratifying to note that the settlers remembered instructions which had been given to them on this point last year.

55. Instruction was also given in the roguing of padi when it had come into ear. This practice is not followed quite so well. It is a somewhat tedious operation and no cultivator appreciated its full significance. This was later brought home to them, however, when the padi was being purchased on behalf of a Georgetown firm. Any padi not pure in sample was rejected and sold to an outside miller at a greatly reduced price. One or two examples of this kind which affect the financial value of the crop, aid tremendously in improving cultural methods. Following on this point, it may be mentioned here, that a greater number of rice millers are now buying on quality of padi brought to their mill. One miller this year gave three different prices based on quality.

56. The yields of padi were good, the total amount harvested from the 243 acres being 4,900 bags. This works out at a little over 20 bags per acre average, which is satisfactory when taken over a whole estate section having all classes of land, and bearing in mind the setbacks previously mentioned. The total yield from this section alone, growing pure line seed, exceeded that reaped from other estates having a much larger acreage. The quality also was far superior. The highest yield reaped from three acres was 82 bags of 155lbs. gross. The final result was as follows:—

1st prize	(\$10.00)—Woozier.
2nd „	(\$ 7.50)—Nepaul.
3rd „	(\$ 5.00)—Sahadutt.
4th „	(\$ 2.50)—Rambaran.

57. *Bush Lot Settlement Garden Competition*.—The conditions of entry governing this competition were as follows:—

- (a) The garden entered to be on the Land Settlement house lots.
- (b) General location of the coconut and other trees to conform with the Agricultural Superintendent's plan.
- (c) Vegetable and flower gardens to be separate.
- (d) Cassava and plantain cultivations not to be eligible.
- (e) Notice to be given by the Agricultural Superintendent as to the closing of entries.

Points to be awarded for:—

- (i) General appearance of the house lot, including flower and vegetable cultivations, coconut seedlings, citrus and other fruit trees.
- (ii) Vegetables :
 - (a) General appearance, irrespective of the number of varieties grown, cleanliness of beds, etc.
 - (b) Arrangement of the beds.
 - (c) Cultivation, attention to manuring tilth, etc.
- (iii) Flower Garden :
 - (a) Arrangement and tidiness of the beds.
 - (b) Variety of flowers.

58. Periodical talks were held by officers and demonstrations given with special reference to the points enumerated above. Advice given was general and not confined to any particular competitor. Great improvement was shown over the previous season when most of the settlers were new to garden work.

59. Special attention was paid to this work during the early part of the year and a demonstration garden—seed and plant material nursery—being instituted. This proved of great benefit to the settlers, who received instruction in the raising of seed in the nurseries and the planting and management of garden plots. The nursery also acted as a medium through which seed and plants were distributed. The response to these efforts was very favourable and some excellent crops were raised, particularly of onions, boughers, eschalots, tomatoes and spinach.

60. The gardens were especially useful and profitable during the drought period in the early part of the year when fresh vegetables in the district were very scarce. This produce was greatly appreciated, being at one time practically the only source of supply. The settlers were able to dispose of it in villages from Queenstown to Hampton Court, and a regular custom was established by them. Supplies of vegetables were also disposed of in the local market. Later, market traders even visited the settlement to purchase supplies. Settlers were advised against selling to these people as better prices could be realised by retailing the produce themselves.

61. A supply of vegetable seed has been ordered on the settlers' behalf and distribution has lately taken place and in this way progress should be well maintained during the coming year.

The results of this competition were as follows :—

- 1st prize (\$8.00)—Leecharan.
- 2nd „ (\$4.50)—Sunderlall.
- 3rd „ (\$2.50)—Prayag.

62. *General Remarks.*—The padi competitions throughout the Essequibo District have been successful this year and the plots of pure line seed have served as an incentive to growers and millers alike. Improved cultural methods have resulted and greater attention is being paid to instructions given.

63. The regular visits of inspection by the district staff have necessitated a great deal of travelling, both on the Essequibo Coast and in Wakenaam island, and these visits have been the means of maintaining the keenness of competitors and attracting the attention of other farmers. The amount of pure line seed harvested and stored for planting purposes is substantial and a great improvement in the quality of the padi grown is anticipated for the next crop.

MISCELLANEOUS.

64. *Reports.*—The following were submitted to the Director during the year :—

- Monthly reports—Henrietta Station and Essequibo District.
- Monthly reports on co-operative credit banks.
- Weekly reports on the Bush Lot Settlers' Cultivations.
- Weekly reports on the Unemployment Relief Works.
- Report on the agricultural competitions.
- Results of the experiments carried out on the Henrietta Station.
- Special reports on the dispute between padi farmers and rice millers in the Essequibo District.
- Reports on land inspection, in respect of persons applying for Crown Lands for cultivation or grazing purposes.
- Report on provision farms in the Anna Regina area. Estimated yields of plantains for submission to the B.G. Producers' Association.

65. *Visitors.*—His Excellency the Governor accompanied by the Director of Agriculture visited Anna Regina in January and again in July. His Excellency was accompanied by Sir Wilfred Beveridge on the former occasion. The Colonial

Secretary visited Anna Regina and the Bush Lot Settlement in May. The Director and Deputy Director of Agriculture paid frequent visits to Anna Regina and the Bush Lot Settlement during the year.

66. In conclusion I wish to add that it would have been impossible to have carried out all the work undertaken this year, without the support and loyalty of the staff, who have worked overtime on many occasions without hesitation or demur.

A. DEK. FRAMPTON,
Agricultural Superintendent,
Essequibo.

January 14, 1932.

DEPARTMENT OF AGRICULTURE.

REPORT OF THE NORTH WEST DIVISION FOR THE YEAR 1931.

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REPORT OF THE NORTH WEST DIVISION FOR THE YEAR 1931.

STAFF.

E. Beckett, F.L.S.—Agricultural Superintendent.
L. E. McKinnon —Foreman.

GENERAL.

His Excellency the Governor (Sir Edward Denham), with his Aide-de-Camp, the Acting Director of Agriculture and the Commissioner of the District, visited the Station at Hosororo on July 2, returning to Georgetown *via* Moruca.

On December 27, 1930, I left for England on leave of absence for six months. Mr. J. D. Gillespie, B.Sc. (Edin.) Agricultural Superintendent, West Demerara, carried out the duties in the district for this period, being relieved on August 26, 1931, on my return to the district.

Visits have been made to practically all the farms in the Aruka, Koriabo, Barima, Kaituma and also to grants on various creeks and most of the areas in the Moruca.

The total miles travelled by boat was 3,826 as against 4,226 miles in 1930.

A certain amount of time has been taken up in the inspecting of land for the Block Survey Schemes.

At Moruca, where the chief pest to the farmer is the Coushi ant (*Atta cephalotes*) a large quantity of carbon-bisulphide was distributed free of charge to farmers; frequent demonstrations were given in connection with the blowing up of nests and the necessary precaution to be taken in the handling of this explosive insecticide.

CROP CONDITIONS.

2. Liberian coffee, the principal crop of the district, experienced a very bad year in respect to prices although at the end of the year these showed an upward tendency. Moderate prices have been realised for ground provision crops. On the whole, the farmers have worked hard and they appear to be learning the lesson, taught by experience, that they should supply most of their wants from the farm, and that credit is a very weak reed to lean upon. Several have made good attempts at paying off their debts.

3. The lime factory at Mabaruma has turned out nearly $4\frac{1}{2}$ times as much raw juice as last year and more than five times the quantity of concentrated juice and four times the amount of distilled and écuelled oil of limes. Unfortunately, towards the end of the year, there was no demand for concentrated juice, consequently the raw juice was allowed to run to waste and only oils were made.

4. Considerable interest has been taken in lime planting and certain farmers are trying out limes on their pegasse areas, about 10 acres have already been planted and there is a demand for the seedlings at the Station. During the year 9,400 seedlings were distributed, 4,700 being asked for by planters in Berbice and elsewhere, whilst 24 acres of budded limes have been planted in the Aruka-Koriabo district on hill lands. The total area now under limes is 125 acres as against 80 in 1930.

5. There has been a demand for budded grapefruit and oranges. The difficulty is to get budwood in good condition to this somewhat inaccessible place. This difficulty will vanish when budwood is available from the areas planted at the Station.

HOSORORO EXPERIMENT STATION.

Coffee.

6. A change was made at the Hosororo Station in respect to coffee experiments, it having been decided to carry on the experiments with Liberian coffee on pegasse only over an area of two acres; the whole of the pegasse flat is to be put under cover crops, chiefly legumes, with the view of obtaining careful data as to whether 'worn out' pegasse lands can be rehabilitated. A start in this direction has been made.

Poison Plants.

7. The experiments with plants of insecticidal value have been continued. Yarakonalli (*Tephrosia toxicaria*) is not easily established and the area under this plant will have to be again 'supplied'. A number of Haiari (*Lonchocarpus* spp.) planted early in 1931, had failed to grow and these were supplied. Further reference to this work at Wauna Sub-station is made in para. 19.

Citrus.

8. The areas under budded citrus fruit have been maintained as have the areas under limes, both budded and seedlings. A considerable amount of work has been done in connexion with citrus during the latter end of the year. Efforts have been made to train boys in budding. This has not been an easy task owing to their habit of working from place to place; frequently just as they are becoming competent, they go off quite unexpectedly. The Aboriginal Indian boy shows little aptitude for work of this nature.

9. At the end of the year there were a number of applicants for budded plants—the demand far exceeding the supply.

10. During the year no budwood of oranges or grapefruit was received this work being confined entirely to Georgetown, but a number of buds taken from selected lime trees were budded on sour orange stock.

11. The total number of plants of each class under cultivation on the lateritic hill lands at the Station (exclusive of citrus nurseries) is as follows:—

Budded grapefruit (including Marsh and Duncan)	...	...	302
Budded oranges	...	...	117
Budded limes	...	...	175
Lime seedlings	...	...	175

With the exception of a few introduced from Florida, the majority of the grapefruit and orange plants were obtained from Trinidad either as plants or budwood and planted out at the Station from 1928 onwards. Further reference to citrus work undertaken at Wauna Sub-Station (sandy hill lands) is made in paragraph 18.

12. *Propagation Work.*—The following shows the position at the end of the year—sour oranges only started to ripen late in December, hence the number of stock raised is small.

	Jan., 1931.	Dec., 1931.	Number sold or distributed.
Number of budded citrus fruit on hand	... 245	Nil	245
Number of budded lime plants on hand	... 1,389	824	2,006
Number of lime seedlings available for distribution	... 27,000	17,600	9,400
Number of lime seeds sown (Sept.-Dec.)	... 63,400	...	...
Number of lime seedlings now germinating	... 60,000	...	...
Number of lime seedlings not yet germinated	... 3,400	...	...
Number of sour orange stock on hand ready for budding in January, 1932	... 2,982	...	...
Number of sour orange stock growing but not ready for buds	... 2,452	...	...
Percentage of success in budding, exclusive of those budded in February, 1931, on old stock but including attempts by pupils	... 48%	...	...

Minor Experiments.

13. An area has been established with budded and grafted pears (both local and imported varieties), and a block of one acre taken up with various spices including grafted nutmegs, cinnamon, tonka beans, tumeric and ginger.

14. The British Honduras mahogany seedlings planted in June, 1929, and December, 1930, have continued to make good growth but, as in the past, they were attacked by *Hypsipyla* sp.

15. Twelve plants of Black Pepper (*Piper nigrum*), one of them being the well-known variety "Balamacotta," were planted out in November with bamboo posts to climb on temporarily and *Gliricidia maculata* as permanent supports.

16. 490 West African Oil palms (*Elaeis guineensis*) were received and will be planted at Hosororo and Wauna, early next year.

17. The three *Hydnocarpus anthelminta* plants are growing well but the same cannot be reported of the six Neem (*Azadirachta indica*), planted February 28, 1930.

WAUNA SUB-STATION.

18. During July, the following budded citrus were planted:—

Parson Brown on rough lemon stock	...	8 plants.
Dancy Tangerine " " "	..	5 "
Navel " " "	...	5 "
Valencia " " "	...	13 "
Limes on sour orange stock	...	42 "
Marsh grapefruit " " "	...	17 "
Valencia " " "	...	5 "
Parson Brown " " "	...	5 "
Navel " " "	...	4 "
Dancy Tangerine " " "	...	3 "
Marsh grapefruit on rough lemon stock	...	14 "
Succadee seedlings (citron) "	...	14 "

and in December, 19 oranges and 29 grapefruit budded on rough lemon and sour orange stock—a total of 4 acres.

19. The Station now contains, in addition to these 4 acres, 4 acres of Black and White Haiari, 2 acres of Yarakonalli (which has to be re-planted) and 1 acre of Arabian coffee, a total of 11 acres. Two acres have been cleared for the planting of lime seedlings early in 1932.

20. These sandy hill soils are not unlike the Moruca soils in appearance, where excellent coconut palms and healthy citrus are grown.

COMPETITIONS.

21. The final judging of the agricultural competitions held in the North West District was carried out during November. The prizes were awarded for the best miscellaneous farm holding of not less than one acre in extent in the following districts:—

Koriabo and Aruka Districts.
Barima District.

The grants were judged on the following points:—

Produce grown and general rotation	...	20
Varieties and quality	...	20
Freedom from weeds, pests and diseases	...	20
Livestock (including poultry)	...	20
Coffee	...	20

22. On the whole, with the exception of the Imbotero Creek, the cultivations seen were up to standard, and, in some instances, a general improvement had been made over the previous year, which is encouraging when one bears in mind the period of low prices which have prevailed.

23. The most notable improvement in the Districts has taken place with live-stock. In many instances, farmers are paying particular attention to their stock, and on some grants, there are as many as 30 to 50 pigs. The poultry seen was not at all unsatisfactory, more than one farmer possessed quite good capons and over 100 fowls, while in one instance there was a good collection of Hymouth Rocks, ducks, guinea fowls, etc. In the Barima District a few farmers have started cattle raising.

24. The prize winners were as follows:—

ARUKA AND KORIABO DISTRICTS.

1st Prize	...	O. Hercules	...	\$20.00
2nd „	...	R. Walker	{ ...	7.50
		Abdul Ghanni	{ ...	7.50
3rd „	...	Makhan	...	5.00

BARIMA DISTRICT.

1st Prize	...	J. Wong	...	\$12.00
2nd „	...	C. Taylor	...	8.00
3rd „	...	C. Poon	{ ...	2.00
		Veeramah	{ ...	2.00

CENSUS.

25. Table I. gives particulars of the acreage under agricultural crops in 1931. There has been a decrease in the total acreage under coffee of 120 acres, but the following increases over last year's areas have been recorded:—

Coconuts	...	...	45 acres.
Cacao	...	...	10 „
Limes	...	...	45 „
Maize, cassava, plantains and ground provisions	...	...	100 „

There has actually been a decrease in cassava, but increases in provision growing and maize have increased the total area by 100 acres in all these crops taken together.

TABLE I.

	Sugar.	Rice.	Coconuts.	Rubber.	Cacao.	Coffee.	Limes.	Other Budded Citrus Fruit.	Tobacco.	Nutmeg.	Maize, Cassava, Plantains, Bananas, Ground Provisions.	Total.
	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Barima	1½	3	24	...	1½	580½	7	...	...	...	372	989
Waini	½	...	8	...	...	49	...	...	...	...	48½	106½
Mora Passage	...	...	½	...	...	26	...	...	...	...	...	26½
Mabaruma	1½	...	3½	...	9½	14	72	1½	...	...	52½	154
Aruka	½	...	14	200	17	818½	36½	...	...	3½	330	1,420
Koriabo	1	...	35	...	42½	452	10	4	½	...	188½	733
Kaituma	...	...	...	...	...	35½	...	...	...	...	7½	42½
Imbotero	...	½	21	...	...	140½	...	...	...	...	151½	313½
Arukama	...	...	2	...	13	...	...	2	...	...	5½	22½
Akakaka	...	...	...	...	16	...	...	...	...	...	13	29
Moruca	...	...	84	...	...	17	...	...	...	...	15	116
	4½	3½	192	200	99½	2,132½	125½	7½	½	3½	1,183½	3,952½

MISCELLANEOUS.

26. *Block Survey Schemes*.—During the year, the Government marked out blocks of land free of survey fees and charges. In the Upper Aruka, sixteen applicants were given areas varying from six to four acres each; on the Hosororo Hills nine applicants received from $5\frac{1}{2}$ to nine acres each, and at Morawhanna fifty-four acres were allotted. The clearings on the hills have progressed satisfactorily, but that on the flat lands has not made much progress owing to unfavourable weather conditions having overtaken the workers, soon after they had made a start.

27. *Co-operation*.—A certain amount of co-operation was carried out in the work of clearing lands under the new Block Survey Scheme—this, it is hoped, will lead to more important work in this direction. An effort has been made to get the farmers to engage in the co-operative marketing of their produce, while one of the farmers proceeded to Georgetown in charge of the shipment, every steamer.

28. *Livestock*.—There has been an improvement in livestock, including poultry and good class birds can now be seen on some of the homesteads.

29. *Diseases and Pests*.—The endemic disease of coffee (*Sclerotium coffeicolum*) has not been so prevalent this year as in previous years—with the exception of attacks on some grants in the Koriabo district. The disease made its appearance later than usual, viz., in the latter part of November and in December. Owing to the low prices obtained for coffee no spraying has been done and little attempt made to combat this fungus. Wilt of tomatoes and boughangers has been present.

30. Looper caterpillars attacked yams in the Barima during May and June but the damage done was not serious. The major insect pest is the blade fly that attacks budded citrus plants. During this year the attacks from this dangerous pest have been most marked on the Station. Limes, up to the present are not attacked. Only three nests of this fly pest were found in the surrounding forests. It would appear that parasitic control is indicated. Coushi ants have not been so troublesome at Hosororo as formerly, but they gave considerable trouble at Wauna. There have been no complaints during the year of attacks from the tannia beetle (*Ligyris ebenus* deG.) cockles.

31. *Distribution of Seeds and Plants*.—During the year the following were distributed by the Station :—

Wild grapefruit seeds for stock—Botanic Gardens, Georgetown.

Rough lemon seeds for stock—Botanic Gardens, Georgetown.

Selected plantain, banana and pineapple suckers, selected cassava cuttings, cucumber, boughanger and tobacco seed, cuttings of <i>Gliricidia maculata</i> .	}	Various farmers in the district.
---	---	----------------------------------

Several articles to the centenary show held in Georgetown.

Budded limes—2,006 to various purchasers.

Budded Marsh and Duncan grapefruit—245 to various purchasers.

Lime seedlings—9,400—free to various farmers.

32. *Boys from the Government Industrial School*.—It has been arranged for a certain number of boys from the Government Industrial School, Onderneeming, to be sent to the Station for training, and accommodation on the Station has been provided accordingly.

33. *Weather*.—The rainfall has been extremely heavy during December, hampering work considerably and proving a stumbling block to farmers trying to dry

their coffee—more especially since the crop this year was very late, picking in earnest not having started until December instead of late October. The precipitation has been as under :

January	...	4·026	July	...	12·069
February	...	4·007	August	...	5·074
March	...	·045	September	...	5·023
April	...	3·003	October	...	8·087
May	...	7·053	November	...	7·087
June	...	13·010	December	...	22·094

34. *Reports.*—The following were the most important reports submitted during the year :—

- Report on balata trees for Forestry Department.
- Report on prize competitions.
- Estimates.
- Monthly progress reports.
- Reports on activities in the District.
- Reports on surveys of lands for block survey scheme.
- Report on present position and possibilities of the North West District.
- Reports on souari nuts and yams, etc.

In official correspondence, 294 communications were dealt with.

EDGAR BECKETT,
Agricultural Superintendent,
North West District.

January 14, 1932.

DEPARTMENT OF AGRICULTURE.

REPORT OF THE SUGAR EXPERIMENT STATIONS FOR THE
YEAR 1931.

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REPORT OF THE SUGAR EXPERIMENT STATIONS FOR THE YEAR 1931.

STAFF.

C. H. B. Williams, Dip. Agr. (I.C.T.A.)	—Cane Agronomist.
C. Cameron	—Field Manager.
L. A. Robinson	—Laboratory Assistant.
L. A. Forte	—Field Assistant.
B. A. McArthur	—Field Assistant.
J. B. Bourne	—Clerical Assistant.
C. L. C. Bourne	—Secretary to the Committee.

Mr. McArthur was appointed on May 22, to replace Mr. Forte during the period of the latter's secondment for work in connection with the soil survey of the sugar estates owned or controlled by Messrs. Booker Bros., McConnell & Co., Ltd.

GENERAL.

2. *Committee.*—The Sugar Experiment Stations' Committee comprised, in January, 1931 ;—

The Director of Agriculture, Chairman.
Hon. G. E. Anderson, Pln. Diamond.
Mr. A. E. Craig, Pln. Ogle.
Mr. J. C. Gibson, Pln. Port Mourant.
Mr. C. Farrar, New Amsterdam.
Hon. R. E. Brassington, Georgetown.
Mr. A. Murison, Pln. Uitvlugt.

3. Mr. Craig resigned on April 8, and Mr. J. Bee, of Plantation Albion, was appointed in his stead. The Committee thus constituted, functioned for the remainder of the year, the Deputy Director of Agriculture acting as Chairman during the absence, on leave, of the Director.

4. *Finance.*—The amount voted on the estimates for 1931 was \$17,199. In addition the sum of \$4,800 was received from the Empire Marketing Board to aid in sugar research. Of this \$1,850 was allocated to the Moth-Borer investigations and the remainder utilized by the Station proper. Without this assistance we would have been unable to recondition and bring into cultivation a large portion of the Station's area which was urgently needed.

5. *Equipment.*—A laboratory has been erected for the use of the Entomologist carrying out the moth borer investigations. A Wiley mill has been installed for disintegrating bagasse samples.

CANE BREEDING AND INTRODUCTION.

6. Further elimination has been made among the varieties produced prior to 1928. The number of each year's seedlings retained for further trials is ;—

1913	... 4	1922	... 34
1917	... 15	1923	... 6
1918	... 6	1924	... 2
1920	... 19	1925	... 1
1921	... 39	1927	... 7

7. These are being extended as rapidly as possible so that they may be tested in field trials. In the meantime, at each extension a rigid selection is made and those which appear inferior are discarded.

8. The following Demerara seedlings are in replicated field tests already started :—

663/13	31/17	403/18	52/20	6/21	309/22	53/27
689/13	92/17	666/18	71/20	173/21	383/22	
695/13	238/17	789/18	73/20	241/21	573/22	
814/12	376/17	835/18	75/20	424/21	593/22	
	447/17		203/20	613/21	602/22	
			204/20	620/21	895/22	
			207/20	684/21	918/22	
			351/20	744/21	927/22	
			557/20	893/21	1034/22	
			571/20	1034/21	1175/22	
			604/20		1221/22	
			628/20		1431/22	
			679/20			
			699/20			

9. With these are being tried the standard cane, D.625, and certain introduced canes like P.O.J.213, 1499, 2714, 2725, 2727, 2878, S.W.3, I.C.T.A. 36, B.E. 10 (12), and S.C. 12 (4), and also Diamond 5, 10, 17, bred locally at Plantation Diamond.

10. The 1928 seedlings have been again selected and extended, and 58 are being carried on for the present.

11. The 1929 seedlings have not yet undergone their second selection. On the first occasion 189 were chosen.

12. The 1930 seedlings have recently undergone their first selection, 141 of the 9,235 put out in the field in March, 1931 have been deemed worthy of further trial. The following is the parentage of the selected seedlings :—

PARENT.		NUMBER SELECTED.	PARENT.		NUMBER SELECTED.
D. 625	...	6	Diamond 10	...	4
D. 145	...	9	Badilla x D. 625	...	18
D. 666/18	...	2	D. 238/17 x S.C. 12 (4)	...	37
D. 1441/22	...	3	Caiara Roxa x D. 625	...	15
D. 53/27	...	5	Diamond 10 x S.C. 12 (4)	...	9
S.C. 12 (4)	...	1	" 10 x B. 6835	...	2
S.W. 3	...	2	B. 6835 x S.C. 12 (4)	...	26
			D. 625 x S.C. 12 (4)	...	2

The 1931 sowings are being made at the time of writing.

13. All the varieties introduced in the past three years are being rapidly extended. The canes introduced this year are :—

B. 726, 755, 891 ; F.C. 916, 998, P.O.J. 2364 ;
P.R. 803, 807, 820, 826 T. 1198, 2020, Co. 281 ;
M.P.R. 7, 42, 44, 49, 63, 132, 145, 151.

These are all growing in quarantine.

EXPERIMENTATION.

Experiments reaped.

14. Eight variety trials have been reaped this year. The results, which have been published in *The Agricultural Journal of British Guiana*, IV., No. 4, pp. 198-204, indicate, so far as tentative conclusions may be drawn from a single series of plant cane trials that

- (i) D.625 is still a satisfactory yielder ;
- (ii) Diamond 10, D.663/13, 814/12, 684/21, 447/17, 666/18, 835/18, and 351/20 are possible rivals of D.625 and, if not definitely better, some of them would, at any rate, be useful substitutes should the standard cane deteriorate.

15. The results of a liming trial, carried out in field 12 West, Sophia, have been published in *The Agricultural Journal of British Guiana*, IV., pp. 64-68. The plant cane crop demonstrated that, on the markedly acid heavy silt in question, statistically significant increases are to be obtained over controls and over each other by doses of 3, 6 and 9 tons, respectively, of ground limestone broadcast before planting and incorporated with the soil during tillage. No further increase in yield was obtained by raising the dose of limestone to 12 tons per acre and there was no response from the addition of half a ton of ground rock phosphate per acre.

16. A manurial experiment on second ratoons at Uitvlugt is reported on in *The Agricultural Journal of British Guiana*, IV., pp. 10-13. On the markedly acid heavy silt of field 14 E. sulphate of ammonia was quite as effective as equivalent doses of two fish manures frequently used on the estate, and much cheaper. The soil does not appear to respond to phosphate or potash and it is likely that 80 lb. nitrogen per acre, in the form of sulphate of ammonia, would prove satisfactory for second ratoons on this soil.

17. In the same issue of the *Journal*, pp. 13-17, the plant cane results from an experiment carried out in field 17 East, Sophia, are reported. The trial demonstrated that kerazotine and leathermeal are not more efficient than sulphate of ammonia at an equivalent dose of nitrogen, though costing much more. The experiment further indicated that 4 cwt. sulphate of ammonia would be an economically sound dose for plant canes on this markedly acid fine silt.

18. A somewhat similar experiment was carried out in field B.L. 47, Plantation Blairmont, on a highly acid heavy silt. The plant cane results, which are reported in *The Agricultural Journal of British Guiana*, IV., pp. 39-63, indicate that kerazotine and leathermeal are not more efficient than sulphate of ammonia at an equivalent dose of nitrogen, though costing twice as much. The further conclusion is tentatively drawn that 600 lb. sulphate of ammonia per acre will probably prove an economically sound dose for plant canes on ploughed lands in this section.

19. The preliminary bamboo drainage experiment in field 4 West, Sophia, has been reaped as first ratoons. The results, which will be published shortly, have again demonstrated that marked increases in yield are to be expected from the bamboo drainage.

20. A more detailed experiment on this subject has also been reaped in field 9 West, Sophia. The results are being prepared for publication at time of writing. They, too, point to a definite and significant increase in yield from bamboo drainage. Plots which had bed drills (open drains) also gave increased yields over undrilled plots. The increases were not as marked as those obtained from the bamboo-drained plots, and in the case of the 1 ft. deep drill, not statistically significant; in the case of the 2 ft. deep drill, however, the increase was significant.

21. A spacing trial with S.C. 12 (4) in field 6 West, Sophia, has been reaped as plant canes. The closest spacing gave the heaviest mean yield, but the differences between the various yields were not sufficiently great to be statistically significant. An interesting feature of this trial was an inverse correlation which appeared to exist between spacing and the percentage of sucrose in the cane.

22. An experiment to determine the loss due to delays between cutting and grinding has been carried out on both burned and unburned cane in co-operation with the Chemist-Ecologist. The results are fully discussed in the report of the Chemist-Ecologist, and will not be repeated here. Suffice it to say that further investigation is needed and that will be undertaken next year.

23. The large fertilizer trial in fields 5, 7 and 8 W. Sophia, described in the last report, has been reaped. The results are being collated at the time of writing.

24. Some preliminary qualitative plots put down last year in fields 5 and 6 W. Sophia, to test the value of synthetic manure made from cane trash and rice straw,

respectively, by the Adco process, have been reaped. No marked differences were to be observed between the treated (20 tons per acre) and untreated plots, although Rice straw manure did appear to have a slight beneficial effect. The plots will be observed as first ratoons.

25. The manurial trial in Walton Hall 56, Hampton Court, was reaped by the estate authorities without an opportunity being afforded to weigh the canes, etc. It has therefore been discarded.

26. The pot culture experiment with flood-fallowing and green manuring, mentioned in the 1930 report, has now been planted up.

Experiments Started.

27. All the experiments reaped during this year, with the exception of the manurial trial in 14E., Uitvlugt, are being continued as ratoons. In addition, there have been started :

14 Variety trials as follows :—

SOPHIA SUGAR EXPERIMENT STATION.

<i>Field 3E.</i>	<i>Field 4E.</i>	<i>Field 5E.</i>	<i>Field 6E.</i>	<i>Field 8E.</i>	<i>Field 9E.</i>
D. 625	D. 625	D. 625	D. 625	D. 625	D. 625
58/27	92/17	403/18	S.W. 3	238/17	663/13
	71/20	6/21	P.O.J. 213	376/17	699/20
	52/20	602/22	P.O.J. 1499	789/18	557/20
	604/20	53/27	B.H. 10 (12)	204/20	571/20
	620/21	I.C.T.A. 36		351/20	744/21
	593/22	P.O.J. 2714		75/20	893/21
	1221/22	S.C. 12 (4)		424/21	383/22
	1431/22	B. 74		1034/21	573/22
	P.M. 625	Diamond 10		1034/22	P.O.J. 2878

SOPHIA SUGAR EXPERIMENT STATION.

PLN. UITVLUGT. PLN. DIAMOND.

<i>Field 10E.</i>	<i>Field 14E.</i>	<i>Field 10Z.</i>	<i>Field a.d. 89.</i>
D. 625	D. 625	D. 625	D. 118
73/20	602/22	695/13	663/13
203/20		666/18	557/20
207/20		835/18	613/21
6/21		204/20	309/22
918/22		571/20	927/22
602/22		173/21	602/22
927/22		602/22	918/22
895/22		S.C. 12 (4)	Diamond 5
1175/22		B.H. 10 (12)	Diamond 10
			S.C. 12 (4)
			P.O.J. 2727

PLN. LUSIGNAN.

PLN. NON PAREIL.

PLN. BLAIRMONT.

PLN. PORT MOURANT.

<i>Field M.R. 22B.</i>	<i>Field 14E.</i>	<i>Field R. 18.</i>	<i>Field A.E. 8.</i>
D. 625	D. 625	D. 625	D. 625
695/13	666/18	663/13	689/13
689/13	699/20	814/12	695/13
666/18	424/21	695/13	835/18
699/20	602/22	835/18	666/18
557/20	309/22	666/18	557/20
613/21	53/27	351/20	571/20
241/21	P.O.J. 2878	557/20	679/20
424/21	P.O.J. 213	424/21	424/21
602/22	S.C. 12 (4)	684/21	602/22
B.H. 10 (12)	Diamond 10	602/22	B.H. 10 (12)
S.C. 12 (4)		Diamond 10	S.C. 12 (4)

All the above are of the randomised block type with the exception of the trials in 3E. and 14E., Sophia, which are combined spacing and variety trials. Three spacings are used for each variety and the experiments take the form of latin squares.

28. *Manurial trial in Field G.D. 86 Pln. Farm, E.B. Demerara.*

Indicator : D. 625

Formulae : (1) Control	(11) Limestone 2 N ₁
(2) N ₁	(12) " 2 N ₂
(3) N ₂	(13) " 2 N ₃
(4) N ₃	(14) " 3 N ₁
(5) Limestone 1	(15) " 3 N ₂
(6) " 2	(16) " 3 N ₃
(7) " 3	(17) " 1 N ₁ K
(8) " 1 N ₁	(18) " 2 N ₁ K
(9) " 1 N ₂	(19) " 3 N ₁ K
(10) " 1 N ₃	(20) N ₁ K.

Where N₁ = 2 cwt. Sulphate of Ammonia per acre.

" N₂ = 4 " " " "

" N₃ = 6 " " " "

" Limestone 1 = 1 ton Ground Limestone per acre.

" " 2 = 4 " " " "

" " 3 = 8 " " " "

" K = 2 cwt. Sulphate of Potash per acre.

Type : Six randomised blocks, plots of 0.06 acre.

Planted : February 7, 1931, Ground Limestone applied January 16-20,

1931. Sulphate of Ammonia and Potash applied March 12.

1931. Canes to be reaped May, 1932.

29. *Manurial Experiment in Field 75 Z, Pln. Uitvlugt, W.C. Demerara.*

Indicator : D, 625.

(2) Ground Limestone 1 ton per acre ; (5) Burnt Lime 1 ton per acre.

(3) " " 2 " " (6) " 2 " "

(4) " " 3 " " (7) " 5 " "

Type : Twelve randomised blocks, plots of 0.06 acre. Limestone and Lime applied in the row just before planting on April 31, 1931. Canes to be reaped September, 1932.

30. *Manurial Experiment in Field G.V. 21, Leonora, W.O., Demerara.*

This experiment is similar in every respect to the preceding one (c) save that the former is on the acid pegasse type of soil, "aback," and this on acid front land clay. The canes will be reaped in September, 1932.

MISCELLANEOUS.

31. *Soil Samples.*—136 of these have been taken and submitted to the Chemist-Ecologist. Composite top and subsoil samples are taken from all areas on which experiments are placed and, in the case of certain manurial experiments and the drainage trials in 4 W., and 9 W., Sophia, special samples are submitted from every plot.

32. *Soil Water Samples.*—Some 40 soil water samples have been forwarded to the Chemist-Ecologist for examination.

33. *Plant Distribution.*—2,990 bags containing more than 400,000 cane cuttings have been distributed locally. This is an increase of 1,000 bags on last year's figure which was, itself, double that of any previous year in the history of the Station.

Favourable reports have been received from the planters with regard to the vigour and appearance of certain varieties, *e.g.*, P.O.J. 2878, D.53/27, D.602/22, and Diamond 10.

34. A few cuttings of some of the better varieties, and also cane fluff for growing seedlings, have been sent to kindred institutions abroad. It is interesting to note that fluff of D.145, packed here over calcium chloride, has germinated even after delays of four months (New South Wales) to six months (Argentina).

35. *Sale of Canes.*—Some 313 puntloads of cane were sold to Plantation Ogle for \$1,441.56, *i.e.*, 259 puntloads and \$1,148 more than last year, and this despite the large amount of cane “drawn down” for distribution.

DOCUMENTATION, VISITS, ETC.

36. Owing to pressure of other work the card indexing of periodic sugar literature has had to be curtailed and little of it has been done during the latter half of the year.

37. The Station staged, at the Centenary Exhibition and Fair, an exhibit of its work which attracted considerable interest.

38. The following have been published by the Cane Agronomist in *The Agricultural Journal of British Guiana* during 1931:—

- (a) “Manurial Experiments with Sugar Cane: I.”;
- (b) “An Experiment with Bamboo Underdrainage for Sugar Cane”;
- (c) “Manurial Experiments with Sugar Cane: II.”;
- (d) “Report on a visit to certain West Indian Sugar Producing Islands”;
- (e) “Variety Experiments with Sugar Cane: I.”;
- (f) “The Breeding and Selection of Cane Seedlings, with special reference to D.625.”

Part II. of (c) was published in collaboration with the Chemist-Ecologist.

39. The quarterly reports on the sugar industry, mentioned in the 1930 report, have been continued during the year; also a monthly report on the Station has been regularly submitted to the Director of Agriculture.

40. A report on the Cane Farming Industry has been presented by the Cane Agronomist in collaboration with the Agricultural Superintendent, East Demerara.

41. The Agronomist was out of the Colony on duty leave for 49 days during which time he visited several of the neighbouring sugar producing islands. A report on this tour appeared in *The Agricultural Journal of British Guiana*, IV., pp. 117-140.

42. Sixty visits have been paid to sugar estates during the year by the Agronomist, Field Manager, and Field Assistant, stays of several days being made when experimental work had to be done. Cordial thanks are extended to Estate Managers and their Staffs for the many courtesies received and for their co-operation.

43. Finally the writer, in closing, desires to thank the Staff of the Sugar Experiment Station for their unstinted support during the year.

C. HOLMAN B. WILLIAMS,
Cane Agronomist.

December 31, 1931.

DEPARTMENT OF AGRICULTURE.

REPORT OF THE CHEMICAL DIVISION FOR THE YEAR 1931.

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REPORT OF THE CHEMICAL DIVISION FOR THE YEAR 1931.

STAFF.

B. R. Follett-Smith, B.Sc. (Lond.), A.R.C.S.—	Chemist-Ecologist.
C. L. C. Bourne	—Assistant Chemist.
L. A. Robinson*	—Laboratory Assistant.

GENERAL.

2. The division has been occupied with soil survey work on the coastlands and in the interior. Special investigations of the effects of flooding cane soils, of the wilt disease of coconuts, of the soluble salt content of cane soils and of the soil types of the interior have been carried out. The division has devoted a considerable amount of time to the design and the statistical reduction of the results of variety and manurial trials with cane, paddy and sweet potatoes. This work has been supported by the examination of soil samples from the various experimental sites and the information obtained should be of great advantage in future advisory work. Numerous analyses of fertilizers, feeding stuffs, pasture grasses and soil waters have been undertaken. A considerable amount of time has been spent in analysing the samples of cane from the variety and manurial trials laid down by the Agronomist. A number of advisory visits have been paid to the plantations of the Colony. During the year one of the large sugar combines of the Colony has provided funds for the detailed soil survey of its estates. This undertaking has given employment to one of the Colony's diplomates of the Imperial College of Tropical Agriculture.

Soil Surveys.

3. During the period under review, four reconnaissance soil surveys have been carried out—

- (a) An area on the left bank of the Demerara River, the proposed site of large scale pineapple cultivation;
- (b) The Kilmarnock Empolder;
- (c) Certain areas of the coastlands in connection with the establishment of market gardens;
- (d) Certain old Dutch plantations on the banks of the Berbice River.

In addition to these surveys, fifteen soil samples collected by the Commissioner of the Rupununi District were submitted to laboratory examination.

Visits.

4. During the early part of this year, the Chemist-Ecologist, on casual leave, visited the Imperial College of Tropical Agriculture in Trinidad. Opportunity was taken to discuss several problems with the members of the staff.

Advisory Visits.

5. During the period under review, twenty advisory visits have been paid to the plantations of the Colony. This work has entailed the collection and detailed examination of a considerable number of soil samples.

Examination of Samples.

6. The division has collected and examined during the year 436 samples of soil. The time of the Laboratory Assistant and the two Laboratory Boys has been

* Seconded from Sophia Experiment Station.

occupied to a certain extent in the analysis of cane samples from the various manurial and variety trials laid down by the Department. This work has reduced, at such times, the number of staff in the general laboratory to two persons—the Assistant Chemist and the Chemist-Ecologist. In previous years only juice samples from the various parcels of canes were analysed. A Wiley mill, for the disintegration of bagasse samples, has now been installed at Sophia and it has been possible, for the first time, to measure the sucrose content of the various samples of cane. This constitutes a considerable advance upon the work of previous years. A rapid electrometric method for the estimation of reducing sugars, used by the Barbados Agricultural Department, has been successfully employed at Sophia during the year.

The following samples have been analysed during the period under review ;—

Soil samples	...	436
Cane samples	...	793
Soil waters	..	40
Lime bearing materials	...	11
Coconut leaves	...	12
Clay fractions	...	10
Pasture grasses	...	3
Fertilizers	...	20
Flooding waters	...	5
Padi	...	4
Press cake	...	2
Feeding stuffs	...	2
Soya bean	...	1
Boiler feed water	...	1
Molasses	...	1
Waters	...	4

SUGAR CANE SOIL INVESTIGATIONS.

7. The origin of the coastal soils of the Colony is usually ascribed to deposition of sea-borne clay transported from the mouth of the River Amazon. Tracts of clay were deposited at the base of the foot hills of the Guianas and were gradually consolidated by the growth of courida and mangrove. At a later stage, due to changing currents, a bank of sand was thrown up which prevented further inundation of the deposited clay by sea water. Periodic flooding by fresh water from the foot hills of the interior eventually reduced the salinity of the clay and fresh water plants colonised the area. Breakdown of plant debris, under the water-logged conditions of the area, was retarded and accumulations of acid organic matter or pegasse, of varying depth, were formed. Changing currents deposited other tracts of clay and, occasionally, of sand to the seaward side of the sand reef and these areas, drained and cultivated by the Dutch, form the front land cane soils of the Colony.

The two main soil types of the Colony's sugar estates are therefore the front land soils and the pegasse soils though, in certain areas where the original covering of pegasse was thin, cultivation has brought about a mixture of this pegasse with the underlying clay.

The front land soils were originally saline sodium-magnesium clays, but irrigation, drainage and the continued application of sulphate of ammonia are gradually transforming them to hydrogen clays. They may vary in texture from heavy loams (index of texture 25) to clays (index of texture 55).

It is of interest to compare the analysis of soil samples obtained at varying distances from the seashore on the East Coast. It should be noted that the values reported for the content of exchangeable bases include any water soluble bases which may be present.

TABLE I.

	D 531.	D 278 and D 280.	D 279 and D 281.	DOCP II.	DOCP V and DOCP VI.	DOCP I.	DOCP III and IV.
Depth	0-1'	0-1'	1'-2'	0-1'	1'-2'	0-1'	1'-2'
pH normal reaction	8.3	7.3	7.6	5.0	6.9	4.5	4.9
pH exchange reaction	8.0	6.8	7.2	4.2	5.9	3.8	3.9
Index of texture	48	47	46	43	49	30	50
Per cent. soluble salts	1.99	0.515	0.675	0.057	0.171	0.019	0.065
Per cent. organic matter	1.07	...	...	1.22	...	1.89	...
Lime requirement Tons CaCO ₃ per acre.	nil	...	nil	5.1	...	11.9	...
Carbon: nitrogen ratio	6.3	...	...	5.7	...	6.8	...
Exchangeable lime mcm. eq 100 gms.	7.79	6.0	4.9	4.95	5.57	5.00	4.50
Exch. magnesia	28.06	18.8	17.4	13.04	17.74	7.79	12.31
Exch. potash	3.71	1.5	1.9	0.49	0.60	0.41	0.35
Exch. soda	31.59	12.7	18.2	1.92	4.56	0.51	0.99
Magnesia: lime ratio	3.60	3.14	3.55	2.64	3.18	1.56	2.74

Sample D. 531 was obtained from a spot some twenty yards to the seaward side of the Sea Wall in the vicinity of Ogle koker. It consists of recent sea-borne alluvium which has been laid down during the last two years and is being gradually consolidated by a growth of *Avicennia* (*Courida*). Samples D. 278 and D. 280 are topsoil samples from the front land pastures situated between Pln. Ogle and the East Coast road. Their site lies some quarter of a mile to the landward side of the Sea Wall. The area is undrained. It is inundated during the rains and is parched during the dry season. Samples D. 279 and D. 281 are the corresponding subsoil samples of D. 278 and D. 280. They exhibited in the field, marked columnar structure. DOCP. II. is a composite of a number of topsoil samples collected from the cultivated front lands of the Ogle group of estates. They are distanced approximately two miles to the landward side of the Sea Wall. DOCP. V. and VI. are composites of a number of subsoil samples collected from the same area. DOCP. I. is a composite of a number of topsoil samples collected from the cultivated back lands of the Ogle group of estates. Their approximate mean distance from the Sea Wall is $5\frac{1}{2}$ miles. DOCP. III. and IV. are composites of a number of subsoil samples collected from the same area.

It will be seen that the alkalinity and salinity of the soils decrease markedly as the distance from the seashore increases. The salinity of the foreshore and the front land pastures is incompatible with the growth of most agricultural crops. These front land soils may receive slight additions of sea salts in the form of spray carried in by the prevailing wind. The amount of exchangeable lime in the various samples shows no marked decrease due, no doubt, to applications of lime which have in the past been part of the estate's routine. Cultivation, irrigation and drainage have had the effect of reducing the contents of exchangeable magnesia, potash and soda, especially in the topsoil.

Salinity of Cane Soils.

8. It should be noted that the composite subsoil sample of the cultivated front lands of the estate (DOCP. V. and DOCP. VI.) contained, at the time of sampling, 0.171% of soluble salts. Bennett & Allison in their book "The Soils of Cuba," commence Chapter VIII. 'Salt in Cuban Soils' with the following paragraph:—

"An important problem is presented by the presence in several areas of soluble salts in the soil. The consequent effect presents three phases: First, the direct injury to the cane, which is experienced where the soluble salts exceed 0.10 to 0.15 per cent., results in a lowering of the yield and in a lowering of the purity of the juice; second, the recovery of sugar at the factory is hindered by the presence in the cane juice of salts absorbed from the soil by the plant. It has been estimated that each per cent. of soluble salts in the juice prevents the recovery of 5 per cent. of sucrose. Third, sufficient traces of salt may remain in the crystals of raw sugar to affect it injuriously in the process of refining, so that sugar from mills deriving their cane from salty areas may be discriminated against by purchasers, particularly in a dull market."

It is of interest to compare, in this connection, the mean figures of the Colony's six biggest factories for juice purity and factory recovery with those obtained in other sugar producing countries:—

TABLE II.

	Juice purity.	Factory recovery Recovery sucrose% Sucrose in Juice.
British Guiana	79.61	87.55
Mauritius	83.70	89.00
Natal	86.04	84.39*
Hawaii	84.00	93.70
Java	84.10	90.10

* (Natal grinds only Uba Cane).

A further paragraph from page 299 of this book may be quoted:—

"Studies in Quality of Canes affected by Salts."—"Three samples of cane, numbered I, II, and III, were taken from the salty clay area discussed above. Another sample No. IV, was taken from normal cane growing on soil without exceptional salinity, found on nearby higher land of good drainage. All four samples were of the Crystallina variety The concentration of salts in the soil from which these samples were taken is shown in Table 13 following. Here also is indicated the total concentration of the cane juice extracted by the hand mill. The salt determinations were made by means of the Wheatstone bridge."

TABLE XIII.

TOTAL SOLUBLE SALT CONTENT OF SOILS FROM THE SOUTHERN PART OF HAVANA PROVINCE AND ANALYSIS OF THE JUICES OF CANE GROWN THEREON.

Sample No.	Depth ins.	Salts in soil per cent.	Salts in cane juice per cent.	Brix.	Sucrose per cent.	Purity.	Glucose per cent.
I	0-12"	0.145	0.999	21.0	19.18	91.20	0.56
	12-24"	0.176	...	...	...	...	...
II	0- 6"	0.178	0.199	20.4	19.67	91.40	0.33
III	0-12"	0.147	0.140	19.0	16.08	84.60	0.63
Average	...	...	...	20.1	18.31	89.06	0.51
IV	0-12"	0.062	0.066	21.2	20.14	95.00	0.39
	12-24"	0.049	...	...	...	...	...

"On the basis of the small samples examined, considerable differences are indicated in the quality of the juice from the canes growing on the salty and that growing on the normal soil. When the relative concentration of electrolytes, as indicated in Table 13 is taken into consideration, it is seen that, from the mill standpoint, the cane juices from the salty soils are considerably inferior."

The content of soluble salts in the subsoils of the cultivated front lands of the Colony's sugar estates vary from 0.005 per cent. to 0.333 per cent. Soil salinity is therefore a problem to be considered by the planters of the Colony.

The effect of Bamboo Under-drainage upon Soil Salinity.

9. The only practical method of removing salts from the soil is by means of judicious irrigation and thorough and efficient underdrainage. The general movement of the water should be maintained downward through the soil and outward in the ground water. The flushing of cane-fields by periodic inundations during dry weather, such as is practised by favourably situated estates, may not only supply water to the cane but will probably dissolve and remove surface accumulations of soluble salts.

The necessity for improved underdrainage on the saline front lands of the cane estates may be exemplified by reference to the bamboo subsoil drainage experiment

carried out at Sophia Experiment Station. This experiment has been criticised on the score of expense, shortage of labour and absence of bamboos. It will have served its purpose if it directs attention to the necessity for underdrainage on saline soils. It should be mentioned, in passing, that the results of the experiment, which were significant, indicated that bamboo subsoil drainage produced a sufficient increase in yield in the first crop to cover the expense of the installation of the bamboos.

A composite sample of the topsoil (0-1 ft.) and of the subsoil (1 ft.-2 ft.) of each plot in this experiment were obtained shortly after the plants were reaped and these samples were submitted to laboratory examination. The results obtained for the topsoils are appended.

TABLE III—TOPSOILS.

Treatment.	Plot.	Yield of cane tons/acre.	Per cent. Salts.	Per cent. Chloride.	Normal Reaction.	Exchange Reaction.
Unpierced bamboo	A	45.41	0.032	0.0165	4.9	3.9
	B	39.63	0.046	0.0240	5.1	4.1
	C	37.02	0.040	0.0148	4.8	4.0
	D	32.03	0.038	0.0210	5.0	4.1
Mean		38.52	0.039	0.0191	4.95	4.03
Pierced bamboo	E	35.00	0.051	0.0198	4.9	3.9
	F	38.00	0.052	0.0206	4.8	3.9
	G	28.07	0.033	0.0178	5.1	4.0
	H	33.76	0.044	0.0185	4.3	3.6
Mean		33.71	0.045	0.0192	4.77	3.85
Control	I	17.47	0.052	0.0263	5.1	4.1
	J	12.34	0.056	0.0352	5.1	4.1
	K	20.94	0.050	0.0262	5.0	4.0
	L	17.12	0.035	0.0180	4.7	3.8
Mean		16.97	0.048	0.0265	4.97	4.00

In addition to the examination of individual samples, composite samples, representing the various treatments, were made up and studied as to their content of water soluble and exchangeable bases. The results obtained were as follows:—

TABLE IV. TOPSOILS.
WATER SOLUBLE AND EXCHANGEABLE BASES MGM. FQ. PER 100 GMS.

	Lime.	Magnesia.	Soda.	MgO CaO ratio.
Unpierced bamboos	4.96	10.85	1.44	2.19
Pierced bamboos	5.04	11.00	1.23	2.18
Control	4.96	11.60	1.79	2.34

Inspection of the results indicates that subsoil drainage has had no effect, during the first crop, upon either the normal or exchange reactions of the topsoil. While the difference in the percentage salts and the percentage chlorides of the topsoils are not statistically significant for the various treatments yet the figures for these two soil constituents appear to be inversely correlated with the yield of cane.

The correlation coefficients obtained are:—

Yield of cane and chloride per cent. in the topsoil ... —0.652
Yield of cane and salt per cent. in the topsoil ... —0.579

Both coefficients are significant.

Since there are many factors operative in determining the growth of cane it is of interest that such high correlations should be shown between the yield and the chloride and salts content of the topsoil.

Bamboo underdrainage appears to have had little effect upon the soil content of exchangeable lime. The exchangeable magnesia and soda, however, appear to have decreased in the underdrained plots, consequently the magnesia-lime ratio is lower in these plots.

The results obtained in the examination of the subsoils are appended.

TABLE V.—SUBSOILS.

Treatment.	Plot.	Yield of cane: tons/acre.	Per cent. Salts.	Per cent. Chloride.	Reaction.	
					Normal.	Exchange.
Unpierced bamboo ...	A	45.41	0.154	0.0710	5.7	4.9
	B	39.63	0.149	0.0800	5.8	5.0
	C	37.02	0.144	0.0580	5.2	4.3
	D	32.03	0.126	0.0552	5.2	4.3
Mean ...	...	38.52	0.143	0.0661	5.48	4.62
Pierced bamboo ...	E	35.00	0.141	0.0585	5.1	4.2
	F	38.00	0.151	0.0595	5.1	4.3
	G	28.07	0.132	0.0582	5.9	5.1
	H	33.76	0.133	0.0565	4.8	3.9
Mean ...	...	33.71	0.139	0.0552	5.22	4.37
Control ...	I	17.47	0.158	0.0731	6.6	5.7
	J	12.34	0.149	0.0690	6.8	5.9
	K	20.94	0.136	0.0606	5.3	4.5
	L	17.12	0.119	0.0622	5.1	4.2
Mean ...	...	16.97	0.140	0.0637	5.95	5.07

The examination of composite samples of these soils yielded the following results:—

TABLE VI.—SUBSOILS.

WATER SOLUBLE AND EXCHANGEABLE BASES MGM. EQUIV. 100 GMS.

	Lime.	Magnesia.	Soda.	MgO CaO ratio.
Unpierced bamboos ...	3.76	13.30	4.58	3.54
Pierced bamboos ...	3.92	12.90	4.63	3.29
Control ...	4.08	14.20	4.64	3.48

Underdrainage appears to have had little effect upon the reaction, salt content or chloride content of the subsoil. The subsoil drains only penetrate to a depth of two feet and it is hardly surprising that their presence has not markedly affected the content of soluble salts in the second foot layer of soil.

Analytical results suggest that there has been a slight loss of lime, a more marked loss of magnesia and no loss of soda in the subsoils of the treated plots. The investigation is being continued and the plots will be sampled after the first ratoons are reaped.

Variation in Salt Content of Soil during the year.

10. During the year an attempt was made to follow the changes in soluble salt content and in chloride content of the soil at Sophia Experiment Station. Two areas, measuring three yards by one yard were marked off in the centre of one of the beds of two fields (16 West and 3 West). Auger samples were withdrawn from ten spots within these two areas. Separate samples were collected from every six inch depth down to two feet. Samples were collected on the 15th June, 1931, and on 16th and 17th October, 1931. The rainfall figures in the fortnights preceding these two dates were 5.64 inches and 0.07 inches respectively.

The content of soluble salts was determined by conductivity methods while the chloride figures were obtained by the electrical method of Best (J. Agric. Sci. XIX., p. 533).

The results are appended :—

TABLE VII.
FIELD 3 WEST.

	Per cent. Salts.		Per cent. Chloride.	
	15th June.	16th October.	15th June.	16th October.
0-6" ...	0.0296	0.0419	0.0104	0.0106
6"-12" ...	0.0468	0.0511	0.0159	0.0104
12"-18" ...	0.1020	0.1075	0.0306	0.0266
18"-24" ...	0.1470	0.1502	0.0425	0.0390

FIELD 16 WEST.

	Per cent. Salts.		Per cent. Chloride.	
	15th June.	17th October.	15th June.	17th October.
0-6" ...	0.0257	0.0165	0.0115	0.0048
6"-12" ...	0.0515	0.0310	0.0218	0.0114
12"-18" ...	0.0872	0.0597	0.0362	0.0253
18"-24" ...	0.1195	0.0912	0.0486	0.0383

Time has not yet been available to examine statistically these results.

The soils of the two areas differ, that of Field 3 West is a heavy silt with a clay subsoil while the soil of Field 16 West is a fine silt. The texture figures are appended :—

TABLE VIII.

	Field 3 West.		Field 16 West.	
	Per cent. Sand. 0.0-0.04 m.m.	Index of texture.	Per cent. Sand. 0.0-0.04 m.m.	Index of texture.
0-1' ...	7.7	43	30.7	38
1'-2' ...	6.3	46	34.0	38
2'-3' ...	...	...	33.0	31
3'-4' ...	...	...	18.0	28

The fluctuations in the depth of the water table in two adjacent fields (No. 4 and No. 13) are as follows :—

TABLE IX.
DEPTH OF WATER TABLE. INCHES.

	Field 4.	Field 13.
Mean depth ...	35.6	22.7
Max. depth ...	42	44
Min. depth ...	27.5	12
Difference ...	14.5	32

It will be seen that in the front land field (3 West) where there is a smaller variation in the water table depth due, presumably, to the heavier texture of the soil, there is an appreciable difference in the salt content of the first sampling depth, the other values remain constant throughout the season. There is no variation in the chloride content of the first sampling depth. The chloride content of the three lower depths appears to be higher in the wet period than in the dry season.

In the lighter soil aback, where the variation in water table depth is more pronounced, the salt content and amount of chloride present is higher after a rainy period than after a dry period.

The fluctuations in soil salinity appear to be more dependent upon the movement of the saline subsoil waters than upon any leaching effects for, with the

exception of the figures for the salt content of the top six inches of the soil of Field 3 West, there is no indication of any loss of soluble salts from the top layer consequent upon heavy rainfall.

Composition of Subsoil Water at Sophia Experiment Station.

11. During the last sixteen months the ground water occurring at Sophia Experiment Station has been under examination. Holes were dug in two fields (4 West and 13 West) and some sixty-two samples were collected and analysed.

TABLE X.

MEAN ANALYSES OF SUBSOIL WATERS PARTS PER MILLION.

	Field 4 West.	Field 13 West.
Chlorine (Cl) ...	3964	1672
Sulphate (SO ₄) ...	650.0	503.0
Bicarbonate (HCO ₃)...	624.6	1040.3
Carbonate (CO ₃) ...	nil.	trace
Calcium (Ca) ...	135.4	91.2
Magnesium (Mg) ...	410.2	235.9
Sodium (Na) ...	2110	989
Mg/Ca ratio ...	3.03	2.58
Total solids ...	8438	4433
Specific conductivity		
mhos x 10 ⁻⁶ ...	12899	5868
pH ...	7.11	7.47
Depth of water table...	35.6"	22.7"

It is of interest that although the water table in the two fields varies considerably during the year, yet no marked differences are noted in the concentration of total solids in samples of the ground waters. It seems probable that the soluble salts are derived from lower stratas of the soil.

The Pegasse Soil Type.

12. The other main soil type of the Colony's sugar lands, the pegasse, consists of an accumulation of acid organic matter of varying thickness overlying an acid heavy clay. Results of the laboratory examination of typical samples are appended:—

TABLE XI.

Sample No.	...	...	...	D 501.	D 502.	TCP VI.	TCP XII.
Depth	...	...	...	0-1'	1-2'	0-1'	1-2'
pH normal reaction	...	...	...	4.7	4.5	4.00-4.99	4.00-4.99
pH exchange reaction	...	...	...	3.8	3.7	3.00-3.99	3.00-3.99
Index of texture	...	...	...	56	53	56-65	56-65
Per cent. soluble salts	...	...	...	0.023	0.020	0.012	0.013
Per cent. organic matter	...	...	...	5.11	...	4.46	2.72
Lime reqt. Tons CaCO ₃ per acre	...	...	...	14.5	...	16.9	15.5
Carbon : nitrogen ratio	...	...	...	14.5	...	10.6	10.0
Exchangeable bases mgm. eq/100 gms.—							
Lime	...	...	...	2.97	2.37	1.44	1.65
Magnesia	...	...	...	2.53	4.16	0.91	0.91
Potash	...	...	...	0.25	0.49	0.08	0.08
Soda	...	...	...	0.03	0.14	0.06	0.03
Alumina	...	...	...	18.82	11.18	24.1	21.8
MgO/CaO ratio	...	...	...	0.85	1.77	0.63	0.55

These samples are composites of a large number of individual samples.

The soils are highly acid and, in general, possess a low content of soluble salts though, in some areas of pegasse, accumulations of soluble salts are noted. The organic matter content is high. The unsaturated nature of the soils is emphasised by their large lime requirements which may, in some cases, reach the figure of 30 tons of limestone per acre. The carbon : nitrogen ratio is wide due to the original accumulation of organic matter under water-logged conditions. The contents of exchangeable lime, magnesia, potash and soda are low, that of

'exchangeable' alumina is usually high. The ratio of magnesia to lime is ordinarily low but in some areas large amounts of magnesia are found and the ratio may reach the value of 6.0.

The soil type by no means occurs in isolated patches of the cane lands. On some estates 50% or more of the cultivated area is of the pegasse soil type. Cane cultivation on pegasse soils sometimes presents a very patchy appearance. Usually the cane on the raised dam beds is more advanced than that on the interior of the field. It is suspected that water supply and drainage have much to do with the successful cultivation of cane in these areas. It is hoped to investigate these points in the future.

Changes occurring in the Cane Soils of the Colony.

13. It is sometimes suggested that the classical and exhaustive manurial experiments carried out by Harrison at the Botanic Gardens in the early part of this century have rendered unnecessary the execution of any further manurial experiments upon the Colony's cane soils. This attitude cannot be supported.

Harrison in 1905 (W.I.B. V., p. 345) stated :—

"The land devoted to sugar cane in British Guiana is of fairly uniform nature and consists of sea-borne clay and sand in varying proportions. In places this alluvial soil is covered by more or less deep layers of a vegetable or peaty soil known locally as 'pegasse.' From the uniform mode of origin of these soils, it follows that, subject to modifications due to the various proportions of clay and sand present and to climatic conditions, results obtained on a station under well-planned arrangements should be applicable throughout the sugar-cane belt of the Colony. Hence it is not considered desirable to multiply in the Colony manurial experiment stations, but to leave it to every manager to use his skilled agricultural knowledge in making the modifications from the methods found advisable on the station on his estate and on the fields under his charge which his experience shows to be desirable to meet their varying conditions of soils, etc."

Harrison, at many points, refers to the alkalinity of the soils of the Botanic Gardens and of the sugar estates. He states in his paper (W.I.B. 1909, pp. 27-28) that :—

"We examined eighty-seven samples of soil from various parts of the Colony which were taken during the dry season from fields the soil water of which was more or less alkaline and we found that the watery extracts from these soils were all alkaline to litmus paper and we proved that the alkalinity was due to the presence of sodium carbonate and of the soluble double carbonate of magnesium and sodium. Thirty-eight of the soil extracts were markedly alkaline, thirty-three alkaline, whilst sixteen were only slightly alkaline."

Cultivation, drainage and irrigation have, during the last twenty years, modified the front land soils of the Colony. A recent detailed survey of the Colony's cane lands which is in progress has indicated that of the 2380 first foot and second foot samples collected only 13 are alkaline.

It seems probable that the sugar-cane soils, at that time, were sodium clays. The idea receives further support from the references to the improvement in soil texture which followed dressings of nitrate of soda (W.I.B. 1905, p. 353) and dressings of common salt (Sugar Cane 1894, p. 527). The sodium salts presumably flocculated the heavy sodium clay and improved its texture.

Discussing the critical figures for available potash, Harrison states that—

"The results we have obtained in our trials with potassic manurings hence cannot be taken as guides for general agricultural practice in the Colony, except

"in cases where the soils are known to be alkaline and to contain more than .008 per cent. of potash which is soluble in 1 per cent. citric acid solution."

On page 9 of the same paper—

"These trials have been made on soils which have a well-marked alkaline reaction. On soils showing an acid reaction, phosphatic manurings may give increased yields of sugar-cane even if the soils yield as much as .010 per cent. of phosphatic anhydride when treated with 1 per cent. citric acid solution."

Enough has been said to indicate that the results of the admirable experiments by Harrison upon alkaline sodium clays cannot be directly applied to the present cane soils of British Guiana which possess a well marked acidity. Further, the results could never at any time be applied to the extensive pegasse soil type.

Conditions in an immature soil are not static, they are forever changing and successful cultivation is only assured by a continued series of experiments.

The Flooding of Sugar Cane Lands.

14. Harrison (W.I.B. 1913, p. 123) mentions the beneficial effects which follow the flooding of exhausted cane-fields in the following paragraphs:—

"It has been noticed, probably first very many years ago by bygone races of planters, that land long under cane cultivation and apparently in a state of temporary agricultural exhaustion if flooded with water and left in that state for some months or even a year or two where the water was drained off and the land replanted sugar canes grew on it with great vigour and gave a succession of heavy crops. This practice has been steadily becoming more in vogue since 1894 when the Hon. R. G. Duncan employed it more or less successfully on Plantation Windsor Forest as a means of combating rind and root disease of sugar-cane. It is difficult to fully explain its action."

No full explanation of the mechanism of the action has been forthcoming. Although numerous suggestions, backed by little or no experimental evidence, have been put forward.

Harrison suggests that—"It is very probable that the vast quantities of water, frequently purely rain water, used for flooding the fields take up from the lower layers of the soil and the upper parts of the subsoil large quantities of the injurious concentrated soil waters, thus lessening the degree of alkalinity of the clays and reducing the proportion of sodium and magnesium salts which are present in the parts of the soil which form the support of plants."

It has been suggested that the acidity of the characteristic creek waters used for flooding is responsible for a marked reduction in the alkalinity of the subsoil. It has been calculated by Crabtree (Rept. Agric. Conditions of the Sugar Cane Industry in British Guiana, 1921) that a foot-depth of these waters contains the equivalent of 27lbs. of sulphuric acid per acre. Such concentrations of acid are unlikely to affect materially the reaction of a heavy clay. The nitrogen content of these waters 4lbs. per acre foot, may be considered negligible.

A further suggestion is that the varied aquatic flora and fauna which thrive during the period of inundation and are subsequently incorporated with the soil, increase its organic matter content. This is obviously not a major factor for ordinary following produces a heavier weed cover but does not give rise to the decided benefits which accrue from submergence. Other possible subsidiary factors may be enumerated. Weeds that compete with cane growth are eradicated. Fungoid and insect pests are destroyed.

It is possible that during submergence a partial sterilisation of the soil takes place and that protozoa, fungi and other micro-organisms are reduced in number

with the consequence that the number of soil bacteria are greatly increased when the field is again brought into cultivation. Such an explanation does not account for the prolonged effects of flooding which persist for two or three years; for it is probable that the population of micro-organisms will become normal in a much shorter time.

Perhaps the most promising explanation of the phenomenon is that the effect is due to the improvement in texture of the heavy sodium clay subsoil consequent upon inundation with water containing small amounts of lime. It is possible too that the presence in the soil of a deaminase such as that described by Subramanyan* may increase the ammonia content of the soil.

It is noted by the planters in regard to this phenomenon :

- (1) That there is an improvement in soil texture.
- (2) That flooded soil assumes a reddish tinge.
- (3) That the greater the depth of flooding water the more pronounced is the effect upon subsequent cane growth.
- (4) That a more marked response is obtained from fields nearer the coast-line than from fields further aback.

Improvement in Texture on flooding.

15. During the present year McKenzie Taylor and Woodman† described attempts to find a cheap field method of permanently improving the texture of sodium clays. They noted that if a sodium clay was shaken up with dilute lime water, the soil settled rapidly, indicating a considerable improvement in texture. It was found, that once the soil had been settled by treatment with lime water, the latter could be replaced by water for a considerable number of times before the improvement in soil texture disappeared. The authors further noted that if the original soil were shaken with lime water (0.091% CaO) flocculation occurred and that the lime water could be indefinitely replaced by a more dilute lime water (0.0091% CaO) without impairing the improved texture brought about by the first treatment.

Preliminary experiments were carried out with a few representative British Guiana soils. Duplicate 1 gm. samples of the soils were placed in 50 cc. test tubes and shaken with 40cc. of lime water containing 0.109% CaO. The contents of the tubes were allowed to settle for 24 hours and the clear supernatant liquid was then carefully withdrawn. One series of tubes was refilled with distilled water, the other with dilute lime water containing 0.0109% CaO. The latter series retained their improved texture even after a large number of irrigations with the dilute lime water. The former series retained their improved texture for the number of irrigations indicated in the following table :—

TABLE XII.

Soil.	Number of irrigation of treated soil with distilled water before deflocculation occurred.	Exchangeable and water soluble soda mgm. eqs. per 100 gms. soil.
B 45 ¹ ...	x x x x x x	5.04
DOCP VI ² ...	x x x x	5.47
D 278 ³ ...	x x x x	13.8
D 280 ⁴ ...	x x x x x	11.5

* Journal of Agri. Sci. XVII, p. 449.

† Journal of the Society of Chemical Industry, June 12, 1931.

¹ B45 Subsoil from a field of Pln. Port Mourant.

² DOCP VI. Subsoil composite sample from the front lands of Pln. Ogle.

³ & ⁴ Topsoil samples from abandoned front lands abutting the East Coast road.

This branch of the investigation will be extended to determine the lowest concentration of the lime water compatible with improved texture.

The Composition of Flooding Water.

16. The water from submerged fields on estates was collected and examined with the following results—

TABLE XIII.
ANALYSES OF FLOODING WATERS—PARTS PER MILLION.

Sample.	A.	B.	C.	D.	E.
Bicarbonate (HCO_3)	30.5	40.6	48.8	...	13.2
Lime (CaO)	9.9	7.4	11.5	4.4	15.2
Magnesia (MgO)	17.2	15.4	15.4	8.7	...
Sulphate (SO_3)	24.9	9.4	11.1	...	...
Chloride (Cl)	33.0	25.0	26.0	...	...
Soda (Na_2O)	25.2	23.2	23.1	12.0	7.9
Potash (K_2O)	...	...	...	3.8	0.4
Ratio of Ca/Na equivs.	0.189	0.154	0.239	0.176	0.805

Sample A.—Sample of water taken from field 63 Pln. Ogle. The field had been flooded for three months when the sample was collected and had been permanently under water during that period. The surface of the water was 6 inches above the crown of the bed and $3\frac{1}{2}$ feet above the four-foot drain. The water was disturbed as little as possible during the collection of the sample.

Sample B.—Sample of water taken from field 70 Pln. Ogle. The field had been permanently under water for eight months prior to sampling. The depth of water on the crown of the bed was approximately $6\frac{1}{2}$ inches and in the four-foot drain $2\frac{1}{2}$ feet. The water was disturbed as little as possible during the collection of the sample.

Sample C.—Sample of water taken from the same spot in field 70 Pln. Ogle. The water was thoroughly stirred up before collecting the sample.

Sample D. was taken from field H.P. 3 Pln. Blairmont. The soil was a pegasse. The field had been flooded solely by the accumulation of rainwater.

Sample E. was taken from field B.K. 20 Pln. Blairmont. The soil was a heavy clay. The field was submerged by rainfall alone.

The average lime concentration of the flooding water is 0.0009 per cent. This is much lower than the concentration employed in the foregoing experiments. This point is, however, to be further investigated.

It should be noted in this connection that the Sudan workers (Rept. Govt. Chemist, Sudan, 1930, para. 24) have shown that soil absorbs calcium preferentially to sodium from different mixtures of the chlorides of the two metals. The mean value for the ratio of calcium equivalents to sodium equivalents in the samples A., B., C. and D. is 0.189 while the value for sample E. is 0.805. Judging from the Sudan results the soil swamped by waters A., B., C. and D. will take from the water roughly 2.5 parts of calcium for every part of sodium absorbed, while in the case of Sample E, the soil would take up 6.8 parts of calcium for every part of sodium absorbed.

These points fall into line with those observed by planters since the greater the depth of flooding water, the more marked will be the penetration into the subsoil. Fields nearer the coastline contain more sodium and more soluble salts. More pronounced improvement is therefore to be expected in these soils.

Soluble Salts Washed out of Surface Soil by Flooding.

17. Assuming that the weight of water on the beds and in the drains of one acre of the field is 840 tons and that the original flooding water (Lamaha water) contains a negligible amount of salts, then the amount of salts dissolved from one acre of the soil by the flooding water is :—

TABLE XIV.
TONS SALTS DISSOLVED PER ACRE OF SOIL.

	A.	B.	C.	D.	E.
Bicarbonate	2.58	3.42	4.10	...	...
Lime	.84	.62	.97	0.37	1.11
Magnesia	1.45	1.29	1.29	0.73	1.28
Sulphate	2.09	.79	.94	...	...
Chloride	2.77	2.10	2.18	...	...
Soda	2.12	1.95	1.94	1.01	0.66
Potash	...	...	...	0.32	0.03

Samples of Lamaha water contain, on the average, 16 p.p.m. of mineral solids which in 840 tons of water is the equivalent of 1.3 tons of mineral matter. The investigation would have carried greater weight, in the case of A., B. and C. if samples had been collected of the water as it was applied to the field. The figures indicate that considerable quantities of salts are removed from the soil by flood fallowing.

Flooding Pegasse Soils with Molasses.

18. It has been noted that beneficial effects are produced when pegasse soils are submerged by water containing molasses at the rate of 5 tons per acre. A typical sample of final molasses was examined with the following results :—

TABLE XV.

Ash (sulphated)	...	...	... 11.20 %
Silica (SiO_2)	...	...	... 0.36 "
Phosphate (P_2O_5)	...	..	... 0.25 "
Sulphate (SO_3)	...	...	... 1.81 "
Chloride (Cl)	...	...	... 1.78 "
Lime (CaO)	...	...	... 0.87 "
Magnesia (MgO)	...	...	... 0.93 "
Potash (K_2O)	...	...	... 3.20 "
Soda (Na_2O)	...	..	... 0.17 "
Nitrogen	...	...	... 0.336 "
Brix	...	...	... 85.3
Direct polarization	...	...	... 28.6
Reducing sugar	...	...	... 24.1 "
True sucrose	...	...	... 31.4 "
Apparent purity	...	...	... 33.6
Gravity purity	...	...	... 36.8
Glucose/ash ratio	...	...	... 2.15
Total sugars	...	...	... 55.5 "

If the rate of application of molasses is five tons per acre the percentage values given above may also be read as cwts. per acre. This treatment costs, with molasses at four cents per gallon, about \$30 per acre. The cost, as fertilizers, of the chief mineral constituents is in the vicinity of \$25 per acre.

Pegasse soils are said to be improved in texture by flooding with molasses and water. The pegasse soils of the Colony are highly unsaturated and usually contain alumina in an exchangeable form. Such soils will tend to take up the bases present, becoming less unsaturated, and probably improving in texture. It is of interest to note that work in America on maize indicates that dressings of potassic manures have beneficial effects in areas where the plants suffer from aluminium toxicity. Possibly some of the beneficial effects ascribed to molasses flooding on pegasse lands are due to the presence in the molasses of considerable quantities of potash.

The sample under examination is one of an exhausted molasses of low purity. The glucose/ash ratio is of an average value. Recent work in Trinidad indicates that if the glucose/ash ratio is above 1.90 a final molasses of low purity may be expected.

The Effect of Flooding on the Ammonia Content of the Soil.

19. The deaminase described by Subramanyan is active in submerged soils. It attacks the asparagine present and transforms it to ammonia which is absorbed by the soil. Measurements of the increase in ammonia content of British Guiana cane soils during submergence were made in the Laboratory. Four quantities of 25 gms. of each soil were weighed out into beakers and flooded by the addition of some 40cc. of distilled water. The ammonia content of two of the samples was immediately determined while the ammonia content of the other two samples was measured after seven days submergence. The results obtained are appended :—

TABLE XVI.

Soil.	Content of ammonia in p.p.m.		Increase.	pH		Per cent. Organic Matter.	C/N.
	Initial.	After 7 days.		Normal.	Exchange.		
D 125	42.0	89.6	47.6	5.60	4.43	1.67	5.5
D 304	33.6	77.6	44.0	4.15	3.85	7.70	13.6
D 509	41.6	70.4	28.8	5.12	2.82	1.35	6.1
DCP XXXVI	12.8	32.0	19.2	4.6	3.7	4.45	10.7
U 402	81.6	97.6	16.0	4.43	3.78	1.57	6.45
D 503	21.6	33.6	12.0	5.42	4.00	1.14	6.7
D 507	14.0	25.3	11.3	4.55	3.73	3.04	10.7
D 430	17.6	26.4	8.8	4.90	4.10	1.41	5.0
D 529	8.0	15.2	7.2	5.5	4.3	1.64	8.2
D 400	8.0	15.1	7.1	4.70	3.83	1.29	6.4
D 501	28.8	34.4	5.6	4.68	3.80	5.11	14.55
B 44	21.6	27.2	5.6	6.0	4.9	2.16	7.00
B 42	19.6	23.6	4.0	5.9	4.6	2.92	7.1

Mean increases 16.8 p.p.m. N.

The mean increase of ammonia, stated as nitrogen, is 16.8 parts per million which corresponds to a dressing of 2.5 cwts. of sulphate of ammonia per acre foot.

Since the changes depend upon the effect of an enzyme it was thought that the reaction of the medium or the amount or nature of the substrate (organic matter) might influence the amount of the increase. It will be seen that there is little connection between the amount or nature of the substrate (as defined by its carbon ; nitrogen ratio) and the production of ammonia. There appears to be no relation between the soil reaction and the increase in ammonia content.

A few of the soils were treated with certain amounts of pulverised limestone in order to vary the reaction of the soil-water mixtures. Appropriate blanks were also examined in each case. The figures are the results of closely agreeing duplicates.

TABLE XVII.
INCREASES IN AMMONIA CONTENT AS N. p.p.m.

Soil.	Increase.	Final pH.	Increase.	Final pH.	Increase.	Final pH.	Increase.	Final pH.
D 430	8.8	4.9	30.4	7.0	39.2	8.6	...	...
D 400	7.1	4.7	9.6	6.4	24.2	7.1	...	...
D 402	16.0	4.4	17.6	5.9	20.0	6.6	20.8	6.7
D 507	11.3	4.6	14.7	6.0	18.8	6.5	19.2	7.2
DCP XXXVI	19.2	4.6	16.2	6.4	16.3	7.2	...	...
D 501	5.6	4.7	6.0	6.1	11.6	8.7	...	...

It will be seen that, with the exception of soil DCP XXXVI, an increase in the production of ammonia, during seven days submergence, is obtained when the soil receives an application of limestone.

The addition of organic matter of wide carbon : nitrogen ratio (50.5) previous of flooding tended to diminish the production of ammonia.

TABLE XVIII.

Soil.		Increase in ammonia content N p.p.m.
D 400 alone	...	15.1
D 400 + 0.25 gm. rice straw	...	14.7

It will be of interest to examine the effect of the incorporation of organic matter of narrower carbon : nitrogen ratio.

The investigations at present indicate that the flood fallowing of cane fields causes :—

- (a) An improvement in texture due to the interaction of the sodium clay with dilute lime solutions.
- (b) The removal of a considerable amount of soluble salts from the soil.
- (c) An increase in the content of exchangeable ammonia.

The flood fallow problem does not lend itself to field experimentation. A pot experiment is however in progress at Sophia.

It is possible that a small application of lime prior to flooding may have the effect of reducing the time of submergence at present considered necessary.

FIELD EXPERIMENTS.

Sugar Cane.

20. *Manurial Trials.*—The manurial trials laid down by the Agronomist shortly after he assumed his duties, were directed towards the comparison of certain organic manures with varied dressings of mineral fertilizers.

The general conclusions drawn from these experiments were that—

- (a) Organic manures were less efficient and more costly than mineral manures.
- (b) Dressings of sulphate of ammonia somewhat heavier than those usually obtaining in the colony may prove economically sound even in the present depressed state of the sugar market.

In conjunction with the Agronomist, several manurial trials have been laid out upon various estates. They aim at determining the most paying application of limestone, the effect of varied dressings of sulphate of ammonia and the cheapest source of lime.

The liming trial at Sophia Experiment Station (Agr. Journ. B.G. IV, No. 2, p. 64) indicated the beneficial effects to be expected from the application of limestone to the cane soils of the Colony.

It should be noted that Harrison in 1905 (W.I.B. Vol. V., p. 346-347) states—

“Upon heavy clay land the action of lime in accentuating its fertility is frequently most marked. We treated every alternate bed in the field with slaked lime obtained from Barbados in the proportion of 5 tons per acre and costing for its purchase and application \$30.

"The excess yields upon limed plots have been as follows:—

Crop Reaped in	TONS OF CANE PER ACRE.	
	Not manured Plots.	Manured Plots.
" 1892 Plants	6.4	7.05
" 1893 Ratoons	8.15	7.4
" 1894 "	3.2	3.45
" 1895 "	3.6	2.40
" 1896 Fallow	...	...
" 1897 Plants	4.3	5.4
" 1898 Ratoons	3.7	4.1
" 1899 "	Crop failed	Crop failed
" 1900 Fallow	...	...
" 1901 Plants	2.5	2.7
" 1902 Ratoons	.6	1.2
" 1903 "	.6	1.4
" 1904 "	.6	1.9
Total increase in 10 crops	33.7	37.0

"Thus in the 10 crops, the results of which are recorded, the lime has on land "not manured produced an increase of 33 tons of canes, and on manured land one "of 37 tons."

The increased yield obtained in this experiment would have paid for itself even with the present low price of sugar.

A fertilizer experiment at Sophia has recently been reaped. The trial includes dressings of limestone, phosphate, potash and three levels of sulphate of ammonia application. It has been impossible to examine the results statistically in time for this statement.

Detailed description of these manurial experiments will be found in the Report of the Agronomist.

Loss of Available Sugar in Exposed Cut Canes.

21. Cane samples from the variety trials upon various estates have been analysed at Sophia Experiment Station. The average sucrose content of such samples was 12.69%, while the average sucrose content of cane ground by the estates during this period was 10.25%*. It seems possible that some of this discrepancy might be accounted for by the fact that the Sophia samples were analysed the day following cutting while the estates canes may have suffered some delay between reaping and grinding. An experiment to test the effect of delay at this stage upon the sucrose content of cane was accordingly carried out.

Half of a certain block of canes growing at Sophia Experiment Station was burnt. Twenty-four 50 lb. samples were cut at random from the burnt area and a similar number were obtained from the unburnt area. Four samples from each area were immediately analysed and a similar number of samples were ground on each of the five succeeding mornings. The results are stated as available 96° sugar per cent. cane and as a percentage of the general mean. Owing to the light expression and the lack of maceration at the experimental mill, the juice purities obtained were considerably higher than those to be expected in the factory. The figures for the available sugar are therefore exaggerated but may be used for comparison among themselves.

TABLE XIX.
BURNT CANE COMPARED WITH UNBURNT CANE.

		Burnt cane.	Unburnt cane.	Mean.	Standard error.
Available 96° sugar per cent. cane	..	12.77	12.59	12.68	0.17
Per cent. general mean	...	100.71	99.29	100.00	1.34

* Taken from the returns supplied by the Sugar Producers' Association.

Under the conditions of this experiment burning had no effect upon the available sugar content of the cane.

The extended results are given in the following table:—

TABLE XX
PER CENT. AVAILABLE 96° SUGAR IN CANE.

	Initial.	Hours delay.					Mean.	Standard error.
		24	48	72	96	120		
Unburned cane ...	13.62	12.87	12.93	13.13	11.39	11.59	12.50	0.417
Burnt cane ...	13.84	12.34	12.91	13.63	12.13	11.78	12.77	...
PER CENT. OF GENERAL MEAN.								
Unburned cane ...	107.41	101.50	101.97	103.55	89.53	91.40	99.29	3.29
Burnt cane ...	109.15	97.32	101.81	107.49	95.66	92.90	100.71	...
Rainfall ins. during previous 24 hours ...	...	0.00	0.01	1.62	0.86	1.07	...	...

It will be seen that under the conditions of the experiment, there was no definite drop in the available 96° sugar content of the unburnt cane until a delay of 96 hours occurred. With such a delay, however, 17.85% of the available sugar in the cane was lost.

The changes occurring in the burnt cane are different and appear to be influenced to some extent by the rainfall. All samples were left exposed in the field. A delay of 24 hours between reaping and grinding burnt cane incurred the loss of 11.83% of the available sugar in the cane. Burnt cane which had been left in the field for 72 hours and had been exposed to a heavy shower of rain was definitely superior to cane suffering a 24 hour delay and was not definitely inferior to cane reaped and ground immediately. This result is of interest in that it suggests that the quality of reaped burnt canes might be maintained while exposed in punts by occasional watering. This point will receive attention in a future experiment during the dry season when certain samples of reaped burnt cane will be watered during their period of exposure. In the burnt cane a loss of 16.25% of the available sugar was incurred by a delay of 120 hours between reaping and crushing.

It should be noted that work by the Agricultural Department of Barbados in 1912 indicated the benefits to be derived by watering reaped cane. Deterioration of cut cane was also noted in the Journal of the Board of Agriculture, Vol. XVIII., No. 3, p. 157.

RICE.

22. *Manurial Trials.*—During the year two survey manurial trials with padi have been laid down, the one at the Experiment Station, Georgetown, the other at the Henrietta Experiment Station, Essequibo Coast in collaboration with the Agricultural Superintendents whose respective divisional reports include extended reference to these trials. The experiments were of a similar nature except that variety H. 7 was used at Georgetown while the Blue Stick variety was used at Henrietta. The nature of the organic material used in the two trials also differed. The trials were laid out in eight randomised blocks each containing 32 treatments. The plots were 1/80th acre in size and each one was provided with its own bunds and buffer rows.

The treatments consisted of:—

Control.

Ground limestone—rate 1 ton per acre.

Superphosphate of lime—rate 240 lbs. per acre.

Sulphate of ammonia—rate 160 lbs. per acre.

Sulphate of potash—rate 80 lbs. per acre.

Organic material—rate 1 ton per acre.

The applications were made singly and in every possible combination.

The composition of the organic material (rice straw) used in the Georgetown trial and that of the dressing used at Essequeibo were as follows :—

TABLE XXI.

Per Cent. Composition on air dry basis.			
		Rice Straw, Georgetown.	Organic material, Essequeibo.
Moisture	...	12.64	19.72
Ash	...	18.0	21.0
Nitrogen	...	0.600	0.891
Carbon	...	30.3	27.8
C/N ratio	...	50.5	31.2
Phosphate (P_2O_5)	...	0.415	0.430
Potash (K_2O)	...	1.148	1.813
Lime (CaO)	...	0.190	0.356

23. *East Demerara Trial*.—Eighteen composite samples (0.6") were collected from the site of this trial. These samples were grouped into one composite sample which gave the following results upon analysis :—

TABLE XXII.

COMPOSITE SAMPLE DCP XLII (0.6").

Normal reaction pH	...	5.18
Exchange reaction pH	...	4.08
Index of texture	...	52
Per cent. Organic Matter	...	1.62
Per cent. Nitrogen	...	0.133
Carbon : nitrogen ratio	...	7.06
Per cent. Soluble salts	...	0.040
Lime requirement tons/acre	...	5.3
Available phosphate*	...	0.0019
Available potash*	...	0.0078
Exchangeable and water soluble bases mgm. eq./100 gms.	...	
Lime	...	2.62
Magnesia	...	11.04
Potash	...	0.31
Soda	...	1.33
Magnesia : lime ratio	...	4.21

A summary of the analysis of variance, in lbs. per 1/80th acre plot is :—

TABLE XXIII.

				Sum of Squares.		Sum of Products.	Correlation.
				Degrees of freedom.	Padi.	Straw.	
Blocks	...	...	...	7	778.44	13778.50	+ 0.7050
Treatments	...	...	...	31	787.31	19490.90	+ 0.4201
Error	...	...	...	217	2553.00	72027.75	+ 0.2485
Total	...	...	...	255	4118.75	105297.15	+ 0.3529

For the padi yields the extended analysis is :—

TABLE XXIV.

				Degrees of freedom.	Sum of squares.	Variance.	$\frac{1}{2} \log_e V.$	Difference.	Z for P* 0.05.
Blocks	...	...	...	7	778.44	111.206	2.355	1.122	0.4064
Treatments	...	...	...	31	787.31	25.397	1.618	0.385	0.2654
Error	...	...	...	217	2553.00	11.765	1.233	...	...
Total	...	...	...	255	4118.75	16.152	...	...	...

* Soluble in 1% citric acid solution on five hours continuous shaking.

There are significant differences in the yields of padi from the eight blocks into which the experiment was divided. The effect of manurial treatment on the padi yield is also definite.

The extended analysis of the straw yields is appended :—

TABLE XXV.

		Degrees of freedom.	Sum of squares.	Variance.	$\frac{1}{2} \log_e V.$	Difference.	Z for P 0.05.
Blocks	...	7	13778.50	1968.36	3.793	0.890	0.4064
Treatments	...	31	19490.90	628.74	3.222	0.319	0.2854
Error	...	217	72027.75	331.93	2.903	...	...
Total	...	255	105297.25	...	...	...	...

There are significant differences in the yields of straw from the eight blocks into which the experiment was divided. The effects of manurial treatment on the straw yield are also definite.

During the experiment careful records of the incidence of "man rice" and of the flowering dates of each plot were kept. The records were subjected to statistical examination. It was shown that the various manurial treatments had no effect upon the flowering date of the padi or on the incidence of "man rice."

Some fortnight before the date of reaping it was noted that a considerable amount of lodging had taken place. Each plot was judged and put into one of the three following classes :—

- (a) Padi standing erect (lodging nil).
- (b) Padi lodging here and there (50% lodging).
- (c) Padi beaten flat (100% lodging).

An analysis of the variance indicated that the effect due to treatment was highly significant and was mainly confined to the phosphate, nitrogen and rice straw applications.

One week before harvesting the individual plots were judged as to their degree of ripeness and were put into one of the three following classes :—

- (1) Padi green.
- (2) Padi half ripe.
- (3) Padi ripe.

It was shown that manurial treatment had had an effect upon the date of ripening. Applications of phosphatic manures and sulphate of ammonia had hastened maturity.

Tables of the significant increases in padi weights, straw weights, the degree of lodging and the degree of ripening are appended in Tables XXVI. A—L.

TABLE XXVI—A.
EFFECT OF SUPERPHOSPHATE ON PADI YIELDS.

	With Phosphate.	Without Phosphate.	Mean.	Standard error.
Bags padi/acre 140 lbs. ...	22.46	21.36	21.92	0.17

TABLE XXVI—B.
EFFECT OF RICE STRAW APPLICATIONS ON PADI YIELDS.

	With Straw.	Without Straw.	Mean.	Standard error.
Bags padi/acre 140 lbs. ...	22.20	21.62	21.92	0.17

TABLE XXVI—C.
EFFECT OF INTERACTION OF NITROGEN AND POTASH ON PADI YIELDS.
BAGS PADI/ACRE 140 LBS.

				With Nitrogen.	Without Nitrogen.	Mean.	Standard error.
With Potash	...	...	...	21.49	22.22	} 21.92	} 0.245
Without Potash	...	...	...	22.53	21.40		

TABLE XXVI—D.
EFFECT OF INTERACTION OF PHOSPHATE, NITROGEN, POTASH AND STRAW ON THE YIELD OF PADI.
BAGS PADI PER ACRE 140 LBS.

				Phosphate.		No Phosphate.	
				Nitrogen.	No Nitrogen.	Nitrogen.	No Nitrogen.
Potash	Straw	...	...	21.59	23.45	21.69	21.38
	No Straw	...	...	22.61	22.44	20.08	21.62
No Potash	Straw	...	...	23.54	21.25	22.46	21.53
	No Straw	...	...	22.62	21.51	21.51	20.62
				General Mean	21.92	Standard error	0.49

The combination of nitrogen with potassic manures appears to depress the expected yield. The combination of nitrogen, potash, phosphate and rice straw depresses the expected yield. The combination of potash, phosphate and rice straw increases the expected yield.

TABLE XXVI—E.
EFFECT OF SEPARATE APPLICATIONS OF LIME, PHOSPHATE, NITROGEN AND POTASH ON THE YIELD OF RICE STRAW.

Treatment.		Tons Straw per Acre.
With limestone	...	3.20
Without limestone	...	3.39
With phosphate	...	3.45
Without phosphate	...	3.14
With nitrogen	...	3.43
Without nitrogen	...	3.16
With potash	...	3.39
Without potash	...	3.20
Mean	...	3.30
Standard Error	...	0.0576

TABLE XXVI—F.
EFFECT OF INTERACTION OF POTASH AND RICE STRAW ON THE YIELD OF RICE STRAW.
TONS STRAW PER ACRE.

				With straw.	Without straw.	Mean.	Standard error.
With Potash	...	...	...	3.35	3.43	} 3.30	0.0813
Without Potash	...	...	...	3.33	3.08		

TABLE XXVI—G.
EFFECT OF SEPARATE DRESSINGS OF PHOSPHATE, NITROGEN AND RICE STRAW ON THE DEGREE OF LODGING.

MEAN MARK.								
	With Phosphate.	Without Phosphate.	With Nitrogen.	Without Nitrogen.	With straw.	Without straw.	General Mean	Standard error.
Mean mark	2.78	2.05	2.57	2.27	2.55	2.28	2.42	0.0545

TABLE XXVI—H.
EFFECT OF THE INTERACTION OF PHOSPHATE AND LIMESTONE ON THE DEGREE OF LODGING.
MEAN LODGING MARK.

	Phosphate.	No Phosphate.	Mean.	Standard error.
Limestone	2.85	1.98	} 2.42	0.0788
No Limestone	2.69	2.13		

TABLE XXVI—J.
EFFECT OF SEPARATE DRESSINGS OF PHOSPHATE AND NITROGEN ON THE DEGREE OF RIPENESS.

	With Phosphate.	Without Phosphate.	With Nitrogen.	Without Nitrogen.	Mean.	Standard error.
Mean ripeness mark ...	2.52	2.11	2.43	2.20	2.31	0.04705

TABLE XXVI—K.
EFFECT OF THE INTERACTION OF PHOSPHATE AND LIMESTONE ON THE DEGREE OF RIPENING.
MEAN RIPENING MARK.

	With Phosphate.	Without Phosphate.	Mean.	Standard error.
With Limestone	2.59	1.99	} 2.31	0.06655
Without Limestone	2.44	2.21		

TABLE XXVI—L.
EFFECT OF INTERACTION OF POTASH AND RICE STRAW ON THE DEGREE OF RIPENING.
MEAN RIPENING MARK.

	With Potash.	Without Potash.	Mean.	Standard error.
With straw	2.43	2.29	} 2.31	0.06655
Without straw	2.16	2.33		

Although a number of treatments, phosphate and rice straw and their combinations give a definite increase in padi weight, yet the gains are insufficient to pay for the cost and applications of the various manures. The straw weights are definitely increased by applications of phosphate, of nitrogen and of potash and are definitely decreased by applications of ground limestone.

24. *Essequibo Trial*.—The analysis of variance of the figures for the padi yields is as follows:—

TABLE XXVII.
PADI YIELDS.—ANALYSIS OF VARIANCE OZS. PER 1/80TH ACRE PLOT.

	Degrees of freedom.	Sum of squares.	Variance.	$\frac{1}{2} \log_e V.$	Difference.
Blocks	7	431671	68810.12	5.570	1.395
Treatments	31	133242	4298.13	4.183	0.008
Error	217	918661	4233.46	4.175	...
Total	255	1533574	...	...	...

The manurial treatments have had no effect upon the yield of padi.

TABLE XXVIII.
STRAW YIELDS.—ANALYSIS OF VARIANCE $\frac{1}{2}$ LBS. PER 1/80TH ACRE PLOT.

	Degrees of freedom.	Sum of squares.	Variance.	$\frac{1}{2} \log_e V.$	Difference.
Blocks	7	300130	42875.71	5.3330	1.2039
Treatments	31	171398	5528.97	4.3134	0.1843
Error	217	837322	3858.63	4.1291	...
Total	255	1308850	...	...	...

The manurial treatments have had no effect upon the weight of straw produced.

25. *Discussion of the Results.*—The mean yield of padi and straw at the two experimental centres and the standard error of the mean of eight plots stated as a percentage of the general mean are appended :—

TABLE XXIX.

	GEORGETOWN.		ESSEQUIBO.	
	Padi (Bags 140 lbs. per acre).	Straw Tons/acre.	Padi (Bags 140 lbs. per acre).	Straw Tons/acre.
Mean yield ...	21.92	3.24	28.32	8.64
Standard error (mean of 8 plots)...	0.69	0.225	0.32	0.196
Standard error (as per cent. of mean)	3.2%	7.0%	2.9%	5.4%

It will be seen that the arrangement of the experiment has produced a low figure for the standard error. The latter is of course reduced for the major comparisons.

Comparison with earlier records of padi yields from the Botanic Gardens indicates that returns on this area have gradually decreased. It is surprising therefore that no combination of fertilizers used in the experiment brought about a paying increase in yield. Earlier manurial experiments by Harrison led to very small increases in padi yield. It is understandable that, in the Essequibo experiment where the general yield was high the application of fertilizers had little effect upon padi growth.

It seems probable that in the Georgetown Experimental area there is some growth inhibiting factor other than the lack of plant nutrients in operation. It should be noted, in the figures given for the laboratory examination of this soil that 72% of the exchangeable bases estimated consists of magnesium oxide. It is possible that the accumulation of this base in the soil, enhanced, no doubt, by the intermittent flooding and fallow, has had a depressing effect upon padi yields. Gedroiz (Soil Science XXXII, p. 51) has noted that oats failed to produce a maximum crop when grown on a magnesium clay although adequate supplies of plant food were available. Espino* suggests that considerable quantities of magnesium are necessary to the growth of rice. Gericket† obtained different results.

It is hoped to be able to investigate this point when soil samples are collected from areas where reliable yield figures can be obtained.

Sweet Potato Manurial Trials.

26. During the year a manurial trial with sweet potatoes was laid down at the Prison Farm, New Amsterdam, by the Agricultural Superintendent, Berbice. The experiment consists of dressings of sulphate of ammonia, sulphate of potash, and superphosphate, singly and in every combination. Soil samples from the area have been examined. The potatoes will be lifted during this month.

Wilt Disease of Coconuts.

27. A certain amount of preliminary work on the soil conditions associated with the incidence of wilt disease of coconuts was described in the report of the Division for the year 1930. It was noted that the "good" area of heavy clay contained more available phosphate than did the corresponding "bad" area.

During the year seven profile pits excavated in wilted and non-wilted areas were examined and sampled to a depth of 42 inches. The thirty-five soil samples obtained were examined in great detail as to their reaction, texture, organic matter, nitrogen

* Espino—Philippine Journal of Science XVI, p. 460.

† Soil Science—XXIX, p. 207.

content, supply of available phosphate, content of readily soluble salts, rates of solution and contents of exchangeable lime and magnesia. The extended table of results is not reproduced here but the general conclusions to be drawn from the figures are (a) that "good" soils contain more available phosphate than do "bad" soils. (b) that "bad" soils contain higher concentrations of soluble salts than do "good" soils.

It was thought that analyses of comparable leaves from vigorous and from wilted trees might give some indications of the growth inhibiting factors in operation. Samples of leaves from unaffected trees and from those in the early stages of wilt were obtained in the following manner:—One leaf from the tree was selected and groups of four or five pinnae were cut from alternate sides of the rachis. The samples were air dried and ground to pass a 1 mm. sieve. It is natural to suppose that the differences obtained between "good" and "bad" material would be small for it is quite possible that palms which were judged healthy at the time of sampling, were subsequently affected.

Pln. Enmore, East Coast.—The leaves selected were the fourth and fifth oldest on the palm. The good leaves were taken from unaffected trees while the bad leaves, though not themselves wilted, came from palms which were obviously affected by wilt disease.

TABLE XXX.—PLN. ENMORE.
PER CENT. OVEN DRY WEIGHT.

	Foulis Empolder E. 3.		Bachelor's Adventure 31.	
	'Good' leaf.	'Bad' leaf.	'Good' leaf.	'Bad' leaf.
Silica	4.100	2.647	4.612	4.000
Alumina	2.202	0.070	0.130	0.206
Ferric oxide	0.148	0.120	0.184	0.177
Calcium oxide	0.381	0.388	0.440	0.626
Magnesium oxide	1.054	1.095	1.186	1.041
Potassium oxide	0.477	0.611	0.649	0.570
Sodium oxide	0.427	0.378	0.171	0.187
Sulphate	0.155	0.173	0.270	0.209
Chlorine	0.880	0.820	0.484	0.567
Phosphate P_2O_5	0.259	0.168	0.240	0.195
Total ash	7.551	6.303	8.176	7.455
Ratio MgO/CaO	2.77	2.82	2.69	1.66

Pln. Tuschen de Vrienden, West Coast.—The samples designated "old leaf" were the fourth or fifth oldest leaves from (a) a healthy palm and (b) a palm affected by wilt disease. The leaves of both samples were yellowing. The samples called "young leaf" were green leaves obtained from the crown of the palm. They were collected (a) from a vigorous palm, (b) from a palm in an advanced stage of wilt.

TABLE XXXI.—PLN. TUSCHEN.
PER CENT. OVEN DRY WEIGHT.

	Old leaf.		Young leaf.	
	'Good.'	'Bad.'	'Good.'	'Bad.'
Silica	6.231	4.084	0.662	0.713
Ferric oxide	0.112	0.863	0.038	0.038
Calcium oxide	0.680	0.525	0.221	0.164
Magnesium oxide	0.938	1.019	0.513	0.501
Sodium oxide	0.216	0.140	0.317	0.319
Chlorine	0.690	0.744	0.895	0.982
Phosphate P_2O_5	0.298	0.291	0.280	0.267
Total ash	9.340	7.940	4.940	4.150
Ratio MgO/CaO	1.38	1.94	2.32	3.06

Pln. Affiance, Essequibo Coast.—The leaves sampled were comparable as regards size and age. The lowest living leaf of the "good" tree was taken while the leaf from the "bad" tree was yellowing but was not definitely wilting or drooping.

TABLE XXXII.—PLN. AFFIANCE.
PER CENT. OVEN DRY WEIGHT.

	CLAY SOILS.		SAND REEF SOILS.	
	Good leaf.	Bad leaf.	Good leaf.	Bad leaf.
Silica	5.208	7.856	4.856	6.791
Ferric oxide	0.611	0.029	0.489	0.381
Calcium oxide	0.332	0.342	0.279	0.366
Magnesium oxide	0.927	0.903	0.569	0.847
Sodium oxide	0.256	0.172	0.149	0.148
Chlorine	0.497	0.528	0.446	0.553
Phosphate P_2O_5	0.259	0.237	0.248	0.241
Total ash	8.190	9.766	8.386	10.395
Ratio MgO/CaO	2.82	2.64	2.04	2.31

Comparing the results of all analyses it will be seen that the "good" leaves contain consistently more phosphate than do the comparable "bad" leaves. While the results here reported by no means prove that wilt incidence is to be correlated with lack of adequate phosphate supply yet the necessity for field experiments with phosphatic manures, in areas where wilt disease of coconuts is prevalent, is indicated. It has been possible, through the co-operation of the proprietor, to lay down such a trial at Pln. Affiance.

MISCELLANEOUS INVESTIGATIONS.

Pasture Grass Analyses.

28. It has been a matter of some difficulty to obtain reliable samples of the average pasturage of the Rupununi savannahs. A number of samples have been received but they have represented either widely occurring grass usually untouched by stock or palatable grasses which are sparsely distributed. Following the visit of the Government Veterinary Surgeon to the savannahs, it has been possible to obtain two representative samples from the Roman Catholic Mission Ranch at Takutu.

A sample of grass collected from the front land pastures abutting the East Coast road in front of the Ressonvenir Estates has also been analysed. The results together with those obtained from the samples collected at Waranama Ranch (Agr. Journ. of B.G. III., No. 3, p. 154) and with representative British and Falkland Island samples are appended.

TABLE XXXIII.
PER CENT. OVEN DRY BASIS.

	Total ash.	Silica free ash.	Phosphate P_2O_5 .	Lime.	Magnesium oxide.	Potassium oxide.	Sodium oxide.	Nitrogen.
Sample A. Takutu ...	6.92	1.73	0.17	0.15	0.17	0.60	0.04	0.70
Sample B. Takutu ...	10.85	2.92	0.28	0.20	0.39	...	...	1.13
T. plumosus. Waranama	6.37	0.83	0.02	0.12	0.12	0.29	...	1.13
T. plumosus. Waranama (recently burnt) ...	8.21	1.25	0.04	0.12	0.10	0.23	...	0.74
A. aureus. Waranama...	10.13	2.31	0.10	0.20	0.62	0.64	...	0.47
Front lands	12.70	7.95	0.78	0.29	0.42	...	...	2.00
Natural pasture. Britain (all grazed) ...	...	5.85	0.67	0.65	...	2.66	0.37	2.50
Falkland Islands	...	4.56	0.54	0.29	...	2.20	0.31	1.95

The front land pasturage here examined is supported by a soil similar to that represented by samples D. 278, D. 279, D. 280 and D. 281, previously mentioned.

The two samples from the Rupununi were labelled:—

A. Pasture cuttings from the R.C. Mission Ranch, Takutu, cut September 21st-23rd, 1931.

B. Horses' favourite grass from the R.C. Mission Ranch, Takutu.

The silica-free ash content of sample A. is higher than that of *T. plumosus* the principal grass of the Waranama savannahs. It is, however, lower than that of *A. aureus* another less extensive natural grass of these savannahs and is markedly lower than the figures obtained with the British natural pasturage and that from

the Falkland Islands, an area where the high mortality among sheep led to an investigation of the mineral content of the pasturage. The silica-free ash content of Sample B. is higher than that found in the Waranama grasses: it is, however, markedly lower than that obtained with the British and Falkland Island grasses. The phosphate contents of the Samples A. and B. are from four to seven times larger than that obtained in the principal Waranama grass, *T. plumosus*. They are, however, lower than those of the overseas grasses. The lime content of the Rupununi grasses does not differ greatly from that of the Waranama grasses. It is much lower than that of the British natural pasturage and slightly lower than that of the Falkland Islands pasturage. The magnesia and potash contents of Sample A. do not differ markedly from those of the Waranama pasture grasses. The soda content of Sample A. is much lower than that of the overseas grasses. The nitrogen content of pasture grass depends to a large extent upon the age of the leaves. It will be seen that the Rupununi grasses compare favourably with the Waranama grasses as regards this constituent. In general the only marked superiority of the Rupununi grass samples over those obtained from Waranama is to be found in the higher phosphate content.

The sample of front land pasturage compares favourably in regard to its silica-free ash content, with those collected from the Government Stock farm (*loc. cit.*). The phosphate content is higher than that of most of the Stock Farm samples and exceeds that of the British natural pasturage. The lime content is low and compares with the mixed pasturage of the farm in this respect. The magnesia content of the sample is lower than that of other grasses of the coastal belt. The nitrogen content of the grass is high. The sample contains an adequate supply of phosphate, magnesia and nitrogen. It is, however, deficient in lime.

Analysis of clay fractions of Mature Soil Profiles.

29. During the year a number of analysis of clay fractions of profile samples obtained from the interior were undertaken. The profiles examined were those described in an article on the soils and pastures of the Waranama Savannah (Agr. Journ. of B.G. III., No. 3).

The sand hill profile gave the following result:—

TABLE XXXIV.

Sample No. ...	D. 47	D. 48	D. 49	D. 50	D. 51
Depth ...	4"-17½"	17½"-37"	37"-61"	61"-122"	122"-139½"
Ignition loss ...	20.92	17.11	16.72	16.12	16.00
Silica ...	38.39	39.93	40.06	39.56	40.53
Alumina ...	30.97	35.01	34.60	34.30	34.53
Ferric oxide ...	5.81	5.39	5.78	5.71	5.74
Titanium oxide ...	2.30	2.55	2.09	2.48	2.33
Silica/alumina ratio ...	98.39 2.10	99.99 1.93	99.25 1.96	98.17 1.95	99.13 1.99

It is remarkable that there is little variation in the silica/alumina ratio of the clay fractions to a depth of nearly 12 feet.

The brown sand profile gave the following results:—

TABLE XXXV.

Sample No. ...	D. 88	D. 89	D. 90	D. 91
Depth ...	0-10"	10"-20"	20"-34"	34"-48"
Ignition loss ...	17.86	16.56	15.53	15.46
Silica ...	37.56	38.11	38.37	38.16
Alumina ...	33.50	34.35	34.99	35.42
Ferric Oxide ...	7.04	6.94	6.94	6.84
Titanium dioxide ...	3.73	3.65	3.92	3.89
Silica/alumina ratio ...	99.69 1.90	99.61 1.88	99.75 1.86	99.77 1.83

There is little variation in the silica/alumina ratio of the clay fractions of this profile. The soil type is apparently a lateritic sand.

It was mentioned in a previous report of the Division that a number of samples of typical igneous rock soil profiles had been collected in company with Professor Hardy of the Imperial College of Tropical Agriculture. It was shown that rocks of difference silica content had given rise to a sandy, acidic surface soil although the weathering processes involved had been different. It was shown that simple determinations of free and combined silica coupled with the application of an alizarin absorption method elaborated by Professor Hardy, demonstrated the weathering changes that had taken place. The work is described in a joint paper appearing in the *Journal of Agricultural Science*, Vol. XXI, p. 739.

Chlorosis of Sugar Cane.

30. During the year the appearance of chlorotic streaks on cane leaves was reported from an estate. Soil samples from the area were examined as to their manganese content with the following results:—

TABLE XXXVI.

		% Mn_2O_3 (oven dry soil).	pH Normal
Affected area			
Topsoil	...	0.0144	5.9
Subsoil	...	0.0169	6.4
Slightly affected area			
Topsoil	...	0.0146	6.6
Subsoil	...	0.0324	6.7

It will be seen that there is little difference in the manganese content of the topsoil of the two areas. The manganese content of the subsoil sample from the slightly affected area is nearly double that of the subsoil sample from the affected area. A search of the available literature revealed very few other soil analyses which might be compared with these figures. The chlorosis was of a temporary nature. It would be of interest to examine affected leaves if any future outbreak is recorded. The results might be compared with those obtained by Lee and McHargue in Hawaii.

The chlorosis may possibly be due to a lack of available iron. It has been suggested that temporary submergence of the affected area might produce conditions sufficiently acid to render available a certain amount of manganese. It is of interest to note that in this case the area was inundated as soon as the disturbance was noted and that the chlorosis quickly disappeared.

Soil Surveys of Sugar Estates.

31. During the year a large sugar combine of the colony offered to provide funds for the detailed survey of the soils of their estates. The survey has been organised by the Chemist-Ecologist, who is responsible for the work. It entails the employment of five local boys who are under the direction of Mr. J. F. Williams, D.I.C.T.A.

Field sampling commenced on June 22, 1931, and up to December 19, 1931, 2,800 soil samples had been collected. Of these samples 2,500 have been submitted to preliminary laboratory examination. The surveys of two estates, covering 2,965 acres, have been completed while field sampling on three other estates has been concluded.

Samples of Soil Profiles.

32. Soil profile pits have been examined and sampled. The preliminary laboratory work in this connection has been completed. The results obtained will be reported in the near future.

Analysis of Filter Press Cake.

33. Two samples of press cake were forwarded from an estate for analysis. In view of the fact that this material is usually returned to the soil it is perhaps of interest to record the data. One sample consisted of fresh cake while the other

represented cake which had been stacked in the factory yard for some time. The results are stated on the air dry basis. In order to compare the gains and losses from the material stacked in the yard the results are recalculated with phosphate taken as unity.

TABLE XXXVII.

	PER CENT. AIR DRY BASIS.		$P_2O_5=1.00$.	
	Old cake.	Fresh cake.	Old cake.	Fresh cake.
Moisture	45.44	64.70	49.93	248.8
Carbon	11.97	14.63	13.15	56.27
Nitrogen	0.98	0.43	1.08	1.65
Total Ash	29.57	5.72	32.49	22.00
Silica	15.49	2.42	17.02	9.31
Phosphate (P_2O_5)	0.91	0.26	1.00	1.00
Lime	3.07	0.75	3.37	2.88
Magnesia	0.64	0.25	0.70	0.96
Potash	0.22	0.25	0.24	0.96
Carbon : nitrogen ratio...	12.2	34.0	12.2	34.0

The old cake has lost a considerable amount of moisture, carbon and potash. It has undergone smaller losses of nitrogen and magnesia. The carbon : nitrogen ratio has been considerably reduced due presumably to the activities of micro-organisms. The ash content of the stacked cake is higher, the increment being mainly due to silica. The old cake may have been mixed with a slight amount of soil or it may have received additions of dust. The slight difference in lime content may be due to differences in factory procedure.

Fresh cake received at the laboratory and exposed to the air, was soon covered with a growth of fungus which was reported by the Government Mycologist to be a member of the *Endomycetaceae*, the presence of such fungi would account in part for the changes brought about in the C/N ratio.

Forest Soil Types.

34. It has been possible occasionally to visit the camps of the survey parties of the Forestry Department. At these times profile pits of various depths have been opened, examined and sampled. The pits have been situated upon the major soil types or in typical forest coverings.

The most widely occurring soil type, the sand hill soil type, has been previously described (Chem. Bull. No. 1, Dept. of Agric. B.G. 1930). Eleven profile pits have been opened in this soil type. The surface soil usually consists of an acid sand stained brown or black with organic matter. Soil texture increases with increasing depth (index of texture 0 to 35). The reaction varies but little throughout the profile unless the parent material is approached. The upper layers (pH 4.5) are slightly more acid than the lower horizons (pH 5.0). The root mat is usually black in colour and overlies a pale brown subsoil. The profile colour shades through buff to salmon-pink and the lower horizons are bright red and in some cases are mottled by large patches of buff coloured soil. The organic matter content of this layer varies from 1.5% to 2.75%. The C/N ratio of this layer varies from 10.5 to 19.7. The nutrient supply throughout the profile is, as a rule, low. The soil type, in forest areas, supports mixed bush or almost pure stands of Greenheart, Morabukea and, very occasionally, Mora. In open areas the soil supports a sparse grass covering. (See Chem. Bull.) *loc. cit.* The silica/alumina ratio of the clay fraction (see para. 29) varies from 1.95 to 2.00. It has been pointed out that the soil type can be derived from varied kinds of parent material though the processes may be different.

Three profile pits have been excavated in the Wallaba sand type. The soil consists of a coarse, white quartz sand. The upper layers may be stained with organic matter. No alteration in the profile has been noted at the lowest depth

excavated (78"). It is difficult to determine the origin of these soils. Harrison originally considered them to be of aeolian origin but later he states (Annual Rept.—Dept. Sci. & Agric. 1914–15, p. 40) that:—

"During the visit to Suriname enquiries were specially directed towards the origin of the vast plains of quartz sand intersected in places by areas of snow white kaolin thinly covered with sand which form so characteristic and wide-spread a feature of the interior lands of the Guianas. Evidence was obtained which clearly pointed to their being residual deposits arising from the weathering of granitic rocks *in situ* and not, as is frequently asserted, dune sands or clastic water-borne sands."

The topsoil is usually acid (pH 4.7) while the deeper soil may be neutral in direction. The carbon: nitrogen ratio of the topsoil varies from 10.5 to 12.7. The ~~index~~ of texture throughout the profile is zero. The nutrient supply is very low. In virgin forest the type supports an almost pure stand of Wallaba. The covering found in the open savannah is of the nature of a scrub. (MARTYN, Agric. Journ.—B.G. IV., No. 1, p. 22).

A less widely distributed soil type is the red earth type previously described (Chem. Bull. No. 1). The reaction varies but slightly throughout the profile. The horizons are heavier in texture and the heaviness increases with increasing depth. The upper horizons are red in colour while the lower horizons vary from brown to sepia. The nutrient supply of these soils is low. The type usually supports an inferior mixed bush.

The Relation of Soil Type to Forest Covering.

35. It has been assumed that the nature of the forest covering is governed by the water holding capacity of the soil. It has been pointed out that Wallaba grows on coarse white sand, that Greenheart is supported by a slightly heavier soil, that pure stands of Morabukea are to be found on soils slightly heavier than those supporting Greenheart and that Mora is supported by the heavy clay abutting the creek beds. The evidence obtained from the examination of profile pits indicates that it is the water supply itself rather than the water-holding capacity of the soil which is the controlling factor in the incidence of different types of forest covering.

One example will serve to illustrate this contention. The soil profile was examined in company with the Assistant Conservator of Forests.

The description of the area is as follows:—

Mora Profile. 11,400 ft. east of the 7th mile post on the Bartica Road. By the Kurumakiabra Creek. Site in a flat area about 20 ft. above high tide level. Not far from creek. Possibly flooded in time of heavy rain. Profile did not appear to consist of alluvial soil but of the decomposition products of gneissose granite. Drainage conditions did not appear to be very good.

The following notes on the forest covering of the vicinity were supplied by the Assistant Conservator.

"Typical mora bush conditions about the optimum in which this type appears to develop. Highest canopy rather open, with a closed under canopy a little below it. Middle tier rather thin, undergrowth fairly dense, consisting chiefly of Mora seedlings. Shade somewhat less than in Morabukea, but rather heavier than in Greenheart.

"(1) Highest canopy:—

"Mora (*Mora excelsa*).

"Crabwood (*Carapa guianensis*).

" (2) Second story :—

" Trysil (*Pentaclethra filamentosa*) which almost forms a definite closed canopy below (1).

" Hubudiballi (*Sionea sp.*).

" (3) Smaller trees and taller undergrowth :—

" Kakaralli (*Lecythidaceae*).

" *Inga sp.*

" Karapaballi (*Guarea trichitoides*).

" Maho (*Sterculia excelsa*).

" Kantaballi (*Licania venosa*).

" (4) Undergrowth (lower) and herbs :—

" Mora Seedlings.

" Okokonshi, small (*Quiina sp.*).

" Yesidan (*Anaxagorea sp.*).

" Dallianna palm (*Geonoma sp.*).

" Aumannibanna (*sp.*) fairly plentiful. A few small ferns.

" Undecomposed leaf covering fairly thin, mineral soil exposed here and there.

" Decomposing organic matter scanty. Ground practically level, aspect N.E. or N."

Laboratory examination of the profile samples obtained gave the following results :—

TABLE XXXVIII.
PROFILE XIII.

Sample No.	...	E 230	E 231	E 232	E 233	E 234	E 235	E 236
Lower Depth	...	3"	8"	20 1/2"	33"	35"	37"	39"
Index of texture	...	16	13	10	7	6	10	0
Reaction pH normal	...	4.8	4.6	4.9	5.1	6.2	5.5	5.2
Reaction pH exch.	...	3.9	4.1	4.2	4.3	4.5	4.7	4.8
Organic matter %	...	2.79	1.46	0.64	0.36	0.38	0.40	0.38
Nitrogen %	...	0.133	...	...	...	...	...	...
Carbon: Nitrogen	...	12.2	...	...	...	...	...	...
Readily available nutrients	...	48	57	29	21	32	21	17
Rate of solution	...	64	23	5	3	9	9	12
Colour	...	Dk. brown	Brown	Buff	Buff	Buff	Buff	Rottenrock

It will be seen that the soil of the profile is a light loam or sand (Index of texture 16-6) and would therefore possess a low water-holding capacity. This is an instance of a stand of Mora supported by a soil of low water-holding capacity the situation of which ensures liberal water supply.

Acknowledgments.

36. The work of the Division has been greatly facilitated by the loyal and unstinted support of Mr. C. L. C. Bourne and Mr. L. A. Robinson.

R. R. FOLLETT-SMITH,
Chemist-Ecologist.

January 14, 1932.

DEPARTMENT OF AGRICULTURE.

REPORT OF THE BOTANICAL AND MYCOLOGICAL DIVISION
FOR THE YEAR 1931.

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REPORT OF THE BOTANICAL AND MYCOLOGICAL DIVISION FOR THE YEAR 1931.

STAFF.

E. B. Martyn, B.A. (Oxon. et Cantab.)—Botanist and Mycologist.
N. Persaud — Laboratory Assistant.

GENERAL.

The Botanist and Mycologist was granted four months' leave of absence and left the Colony on June 11. He resumed duty on November 27.

DISEASES OF CROPS.

Sugar Cane.

2. *Root Disease*.—At the beginning of the year this disease was again reported as fairly prevalent on an estate on the Corentyne Coast, but was stated to be confined principally to the dam beds. Its outbreak coincided with the beginning of the rains after a long dry period.

3. On the same estate, a small experiment was laid down in July, 1929, to observe the effect of manurial treatment on Root Disease. A dam bed which had been subject to the disease was divided into six plots of 29 rows each, three of these plots being untreated and three treated with stable manure and lime at the rate of 40 tons and 2 tons per acre respectively. The application was made when the plant canes were some $4\frac{1}{2}$ months old. The results were negative, no apparent difference in the amount of disease on treated and untreated plots being noticeable, either in the "plants" or first ratoons. It is possible, however, that the application of lime was not sufficient, and these trials will, therefore, be continued.

4. *Chlorosis*.—Attention was drawn in April to a chlorotic appearance of cane on the abovementioned estate in the Corentyne. Only one field was concerned, which contained for the most part D.625, with 14 rows of seedling 203 in one corner. The cane had just begun to "spring" for the second ratoon crop. A large number of shoots of the 203 were markedly chlorotic. In many cases the whole shoot was affected and in others the greater part of the leaf was white, with a small green strip remaining near the base. Some of the smaller chlorotic shoots showed a tendency to dry up and wither.

5. Amongst the D.625 in the neighbouring part of the field, stools with a similar appearance were common, and in the farther parts of the field, isolated instances were to be observed. Fearing an infectious disease, the area of the field containing the 203 had been partially flooded as soon as the chlorosis was seen. Within a week, however, the chlorosis was observed to be markedly less, and when the disease was diagnosed as non-infectious the water was withdrawn. A month later, the chlorosis had largely disappeared, though a number of sickly looking stools remained, especially on the dam bed which had not been flooded.

6. This type of chlorosis resembles closely that described and figured from other cane-growing countries and attributed to a deficiency of Manganese. In this case, subsequent analysis of the soil by the Chemist-Ecologist suggested that the chlorosis might be due to a temporary deficiency of available Manganese, or possibly to a shortage of available iron. Isolated cases of similar chlorosis have been seen previously among young "plants" on a dam bed of the same estate. As the cane developed, they entirely disappeared.*

* Agric. Jour. of B.G. III. No. 4, p. 227, 1930.

7. An apparently similar disease was reported early in November as occurring on a small patch of D. 602/22 seedling in a field of a neighbouring estate.

RICE.

8. *Man Rice*.—Inoculation Experiments were carried out with the *Fusarium* found associated with the discoloured basal nodes of diseased plants. The fungus proved capable of killing rice seedlings in pots, but the slight incidence of the disease on the crop itself suggests that the prevailing field conditions are adverse to it.

9. It is of interest to note that an apparently exactly similar disease has recently been reported from Madras, where however the damage done is more serious.

COFFEE.

10. *Sclerotium Disease*.—The seasonal outbreak of this disease in the North West District is reported as being of a mild nature.

COCONUTS.

11. *Wilt*.—A small experiment has been laid down on an estate in Essequibo to observe the possible effect of phosphatic manures on the incidence of the disease. This, together with other observations on the disease, is dealt with in the report of the Chemist Ecologist.

PLANTAINS AND BANANAS.

12. *Wilt Disease*.—Further cases of this disease were examined at Coverden where, as has been observed elsewhere, the outbreak was worst on pegass soils. The area concerned was poorly drained, and at times liable to flooding.

BOTANICAL INVESTIGATIONS.

Rice Grass.

13. The experimental planting of this grass (*Spartina Townsendii*) on the fore-shore at Lilliendaal has been kept under observation. The plot near the sea wall, only covered by spring tides, has died out. The plot farther out, on the mud, and covered by every tide, has however maintained itself well, and the plants are spreading in the area where they were set out. Their extension is slow and they have not yet come into direct competition with the local species (*S. brasiliense*).

JENMAN HERBARIUM.

14. A collection was made of a number of specimens (totalling approximately 100 numbers) when accompanying the officers of the Forestry Department in the neighbourhood of the Lower Cuyuni River in the early part of the year. Herbarium sheets of this material were prepared, duplicates being made wherever possible, and the specimens were forwarded to Kew. Determinations have subsequently been received.

15. While the members of the Forestry Department were carrying out their survey on the Cuyuni, specimens collected by them were periodically forwarded to the Herbarium, where they were properly dried and poisoned, and stored pending the officers' return to Georgetown.

16. Determinations were received from Kew early in the year of a number of the specimens forwarded for identification during 1929 and 1930.

17. The material of the Orchidaceae lent to the New York Botanical Gardens in 1928 has now been returned, after examination by Professor Ames.

18. Material of the Genera *Aegiphila* and *Danaea* was loaned during the year to interested authorities, and duly returned.

19. A visit was paid to the Herbarium and Botanic Gardens in March by Professor R. B. Thomson, Professor of Botany at Toronto University.

20. A visit was also paid to the Herbarium by Mr. R. E. Montgomery, Chief Veterinary Adviser to the Colonial Office, who was interested in the collection of fodder plants and pasture grasses. In this connection also, some 30 specimens of grasses, etc., collected in the Rupununi by the Government Veterinary Surgeon and others, were mounted and forwarded to Kew. Determinations of a number of these have already been received.

21. The routine work of the Herbarium has been carried out as usual, and a start is being made with the preparation of a card index of the collection.

E. B. MARTYN,
Botanist and Mycologist.

December 31, 1931.

DEPARTMENT OF AGRICULTURE.

REPORT OF THE BOTANIC GARDENS FOR THE YEAR 1931.

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REPORT OF THE BOTANIC GARDENS FOR THE YEAR 1931.

STAFF.

E. B. Martyn, B.A. (Oxon. et Cantab.)—Superintendent of Gardens.
 H. A. Cole —Horticultural Assistant.
 G. L. Leitch —Clerical Assistant.
 M. Sheriff —Nursery Foreman.

GENERAL.

The Superintendent was absent from the Colony on leave from June 11 until November 26.

2. Attention has been paid during the year to improving the general appearance of the Gardens and to increasing their attractiveness to visitors. An especially good display of flowers was to be seen at the time of the Centenary Celebrations in October, and the present condition of the Gardens as a whole reflects great credit on the work of all the staff.

3. The following table shows the amounts spent under the different votes :—

	Vote.	Expenditure.
Botanic Gardens Maintenance ...	\$ 5,000	\$ 4,990.52
Purchase Production and Distribution		
of Seed ...	3,000	2,982.73
Cutting Grass for Police Horses ...	1,100	1,095.54
Georgetown Government House and		
Public Buildings ...	1,600	1,596.51

FRONT GARDEN.

4. Two consignments of seed of flowering plants were purchased during the year, and a variety of flowers maintained in the beds and borders.

5. It is intended to border the paths round the outskirts of the front Garden with a number of small flowering trees and shrubs. With this end in view, plants of *Solanum macranthum*, and of a large species of *Ipomea* have been planted at intervals along the paths on the north and south sides respectively. A number of varieties of *Bougainvillea* have also been planted beside the path on the northern side, and an avenue of Flamboyante trees (*Poinciana regia*) has been planted beside the path east of No. 2 lake.

6. Several clumps of *Thysanolaena agrostis* have been added to the other ornamental grasses around No. 2 lake. An unsuccessful attempt was made to establish further plants of the palm *Nipa fruticans* at the east end of this lake. A renewed effort will be made next year.

7. The trees and bushes on the south border, immediately behind the Grand Stand of the D'Urban Park Race Course, were thinned out considerably to allow more breeze to reach the stand.

8. A Hibiscus hedge was planted along this border and continued along the southern edge of the Deputy Director's garden.

9. Eighteen different varieties of Hibiscus were planted out in a bed in the south section.

10. Three plants of *Aleurites fordii*—the Tung Oil tree, were planted out near the north border. Only one has survived, however.

11. The shelter near the Bandstand was reduced in size and re-thatched with troolie. The Bandstand itself was repainted and two of the wooden bridges nearby were renovated.

12. The plan of the trees and major shrubs in the Gardens was continued to include the north section of the front Garden.

LAWNS.

13. The lawns have been maintained in order. Cracks have been filled in near the Bandstand and the manatees' feeding place, where visitors walk on the grass.

PARK LANDS.

14. The usual cleaning of the Lily Ponds and trenches was carried out. Antidesma and other unwanted bushes have been cut back and Razor Grass forked out in certain areas.

15. A number of seedlings of Haiariballi were raised from seed collected in the "bush" and 7 plants have been set out in the Park Lands. Some 10 plants of a local species of *Bignonia*, also from the forest, have been planted at the base of the Saman trees bordering the northern side-line trench.

16. The small plot of Ginger Lily, *Hedychium coronarium*, which had existed in former years near the cowpen, was re-established.

17. The bridges on the North Serpentine Road were renovated.

ROADS.

18. The condition of the roads had become very bad, partly owing to the fact that no extensive repairs had been carried out for many years, and also owing to the increased motor traffic upon them. The D'Urban Park gap above the Race Course is impassable in wet weather, which necessitates all traffic to Sophia and the Experiment Station, including a number of heavy lorries, using the central avenue.

19. With assistance from Sophia and the loan of the prison gang from the Experiment Station, repair work was carried out on a large scale. Four heaps of earth were burnt and the avenue renewed from the top to the iron bridge. A roadway was made, 12 feet wide and 4 inches in depth, fine earth scraped from the parapet on either side being used to bind the surface.

20. In addition to this, a new surface has been made at the lower end of the avenue, from the circular bed to the entrance gates, a central roadway, 12 feet wide, being thus repaired.

21. The surplus burnt earth has been used for patching.

NURSERIES.

Ornamental Section.

22. The covering of the floor of this section with shell was completed, with very good effect.

23. A considerable number of Hibiscus cuttings were provided for the preparation of hedges in the Gardens, and at a number of other places, including the Young Women's Christian Association.

24 One hundred and fifty Tamarind seedlings were raised and sent to Anna Regina, Essequibo, for planting as shade trees.

25. Many orders for roses were received during the year, and as much budding done as possible.

26. A number of ornamental plants were provided for the Department's stand at the Centenary Exhibition and for general decorative purposes.

27. A small exchange of orchids was made with a local collector, the following new plants being received :—

Bulbophyllum Leopardamme.

Cattleya Loddigesii.

C. Luddemanniana Lowii.

C. Wavriana.

Dendrobium deonianum.

Cattleya granulosa.

C. Luddemanniana.

C. Speciosissima.

Coelogyne flaccida.

28. An unusually fine display of flowering orchids was in evidence during July and August, at one time over twenty specimens being in flower at the same time.

29. In cases where the collection includes several specimens of the same species, the individuals have been numbered, in order to keep a check on their periods of flowering.

30. One or more specimens of the following orchids flowered during the year :—

†*Aerides odoratum*, *Angraecium-eburneum*, **Aspasia epidendroides*, **Bletia purpurea*, *B. paetula*, *Bollea coelestis*, *Brassia caudata*, *B. Lawrenceana*, **Catasetum scurra*, *C. sp.*, *Cattleya Bowringiana*, *C. Jenmanii*, *C. labiata*, *C. labiata vars.*, *Gaskelliana*, *Imperialis*, *Mossiae*, *Speciosissima*, *Superba and trianae*, *C. Luddemanniana Regina*, *C. Schroederiana*, *C. Skinneri*, *C. Warocqueana*, *C. sp.*, *Cymbidium pendulum*, *Cynoches Dianae* †*Dendrobium aggregatum majus*, *D. lituiflorum*, †*D. Moschatum*, †*D. nobile*, *D. phalaenopsis*, *D. superbum*, *D. transparens*, *Diacrium bicornutum*, *Epidendrum ciliare*, *E. difforme*, *E. fragrans*, *E. osmanthum*, *E. stenopetulum*, *E. sp.*, *Gongora atropurpurea*, *G. maculata*, **Hexisia bidentata*, **Lycaste*, *Powellii*, *Miltonia spectabilis*, **Mormodes atropurpureum*, *Oncidium altissimum*, *O. lanceanum*, *Phalaenopsis amabilis*, *P. Esmeralda Regnerii*, *Renanthera coccinea*, *R. secunda*, *Schomburgkia Lyonsii*, *Sobralia sessile*, *Stanhopea eburnea*, *S. Wardii*, **Trichophila maculata*.

ECONOMIC SECTION.

31. *Citrus*.—The principal activities in this section were concerned with the output of budded citrus. The following table indicates the extent of the work done :—

PRODUCTION AND DISTRIBUTION OF BUDDED CITRUS DURING 1931.

	No. of Plants budded.	No. of Plants basketed.	Percentage of successful buddings.	No. of Plants distributed.	No. of Plants distributed in 1930.
Oranges	3,268	965	29.5	853	191
Grapefruit	3,342	1,585	47.4	1,383	268
Total	6,610	2,550	...	2,236	459

* Specimens obtained last year from the Panama Canal region.

† On the trees in the Almond Grove.

DISTRIBUTION OF CITRUS—1931.

	ESSEQUIBO.			BERRIERE.	N.W.D.	DEMERARA.			
	Wake-naam.	Parika.	Other districts.			George-town.	West Bank.	East Bank.	East Coast.
Budded Oranges ...	180	...	...	70	53	38	281	148	93
Budded grapefruit ..	217	348	30	618	66	20	48	16	20
Limes—budded ...	...	...	50	2	...	9	50	6	...
Limes—seedling ...	100	...	...	...	...	103	13	124	2

32. The output of citrus was by far the largest as yet recorded from the Gardens, but would undoubtedly have been much larger were a supply of suitable budwood obtainable locally. Pending the development of the trees planted by the Department to fulfil this want however, nearly all the budwood has to be obtained from outside the Colony. This entails unavoidable delays in budding, and also reduces very considerably the number of successful propagations. The budwood obtained is not always of the best quality, and sometimes has to undergo a journey of several days, in the course of which the material sent often deteriorates. The above figures show the low percentage of successful buddings obtained. That this is not due to lack of skill on the part of the staff, a case may be instanced in which some 50 buds were selected from a local Parson Brown orange tree and 98 per cent. success was obtained from the budding.

33. As a further instance of the difficulties caused by having to obtain budwood from away, it may be recorded that one consignment of Marsh and Duncan grapefruit propagating material received during the year, was not labelled. It has therefore been necessary to distinguish the resulting plants as Grapefruit A and B, their true identity being unknown until they have developed.

34. Further beds to contain the citrus plants were made east of the nursery, and to ensure proper drainage of these, bamboo under drains were laid down.

35. One hundred and fifty limes were received from the North West District early in the year and have been sold, or distributed to other Experimental Stations,

36. *Mangoes*.—Many orders for grafted plants continued to be received and a large number were supplied. The following table indicates the work done:—

Variety.	Julie.	Ceylon No. 1.	Mrs. Dare.	No 11
No. of Grafted Plants taken off ...	102	42	23	22

Variety.	Bombay Purple.	Colonial Bank.	Chinoise.	Divine.	Egerton.
No. of Grafted Plants taken off ...	14	7	8	1	2

37. Several older trees of inferior variety, at the Nursery and the Experiment Station, were cut back preparatory to being top worked.

38. *Cocoa*.—Two thousand seedlings were raised and basketed, to fulfil the order for a local firm, who desired them for planting on their estate in the North West District. Seed was obtained from Trinidad from trees of a good type.

39. *Oil Palms*.—It is intended to carry out some experimental planting of the African Oil Palm (*Elaeis guineensis*) in the North West District. With this end in view, seed was obtained from the Department of Agriculture, Nigeria, from trees of several varieties, and also from Oil Palm trees growing at Suddie. Seven hundred and ninety seedlings raised were basketed, and are being despatched to Hosororo. A further consignment of Oil Palm seeds was received from Java, but unfortunately these failed to germinate.

40. *Miscellaneous*.—The following plants were received from the Department of Agriculture, Dominica, and planted in the Nursery and at the Experiment Station: *Piper Nigrum*, 12 plants, and one plant each of *Acacia sphærocephala*, *Congea tomentosa*, *Crossandra undulæfolia*, *Dombeya Punctata*, *Eugenia Jambolana*, *Lagerstroemia flos-reginae*, *Nephelium Litchi*, *Piper Nigrum* var. *Balamcotta*, *Sapindus inæqualis*, *Spiraea Reevesiana*.

41. The following tables indicate the general activities of the Gardens during the year:—

TABLE I.

	Economic Section.	Ornamental Section.
Plants bedded out ...	6,718	24,072
Plants basketed or potted ...	6,734	4,966
Plants rebasketed or repotted ...	297	1,605
Plants grafted or budded ...	7,778	...
Plants ringed ...	118	1,834
Plants top-dressed ...	...	648
Seeds sown (apart from packets) ...	21,981	217

TABLE II.

PLANTS SOLD OR DISTRIBUTED.

Economic Section.				Ornamental Section.			
Budded Orange	—Parson Brown	...	347	Ferns	—Maiden Hair	...	285
"	—Navel	...	160	"	—Other types	...	104
"	—T. H. Late	...	211	Roses	—'Patience'	...	136
"	—Other varieties	...	135	"	—Other varieties	...	203
Budded Grapefruit	—Marsh	...	868	Palms	—Licuala grandis	...	275
"	—Duncan	...	68	"	—Ptychoraphis augusta	...	141
"	—Var. A.	...	345	"	—Ptychosperma Macarthurii	...	47
"	—Var. B.	...	102	"	—Chrysalidocarpus lutescens	...	40
Limes—seedlings	...	...	342	"	—Pritchardia pacifica	...	37
" budded	...	...	117	"	—Other species	...	120
Grafted Mangoes	—Julie	...	84	Begonia	...	...	168
"	—Ceylon No. 1	...	33	Bougainvillea	...	...	43
"	—Other varieties	...	49	Ocrotan	...	...	109
Cocoa	...	...	2,257	Hibiscus	...	...	271
Coffee	—Liberian	...	295	Impatiens	...	...	74
"	—Creole	...	50	Ixora	...	...	35
Avocado Pear	...	...	246	Jasmin (double)	...	...	25
Papaw	...	...	279	Lagerstroemia	...	...	36
Sapodilla	...	...	186	Petrea	...	...	88
Miscellaneous (including:—Averrhoa Bilimbi, A. Oar-ambola, Bread Fruit, Bread Nut, Bell Apple, Genip, Golden Apple, Governor Plum, Granadilla, Guava, Mamee Apple, Nutmeg, Pomegranate, Semitoo, Soursoop and Star Apple)	...	...	577	Plumbago	...	...	151
				Miscellaneous	...	...	236
Total	...	...	6,751	Total	...	...	2,624

TABLE III.

REVENUE RECEIVED DURING THE YEAR 1931.

	Sale of Plants.	Sale of Bamboo.	Sale of Lilies.	Hire of Plants.	Miscellaneous. Sale of Pots, Seeds, Bulbs, Cuttings, Fruits, Package, etc.
January	\$ 15 12	\$ 4 85	\$ 3 45	\$ 6 52	\$ 6 94
February	25 16	2 33	2 13	...	4 73
March	25 66	1 60	1 82	5 68	1 08
April	47 94	2 99	1 90	...	72
May	70 26	4 20	8 08	1 20	2 54
June	82 78	4 84	2 36	1 32	6 18
July	28 62	3 48	5 34	...	36
August	18 04	2 24	3 14	...	36
September	24 68	2 96	4 12	96	3 58
October	27 58	4 72	4 06	...	2 60
November	41 46	2 64	2 39	48	1 24
December	45 02	11 06	1 86	2 52	92
Total	\$ 452 32	\$ 47 91	\$ 40 70	\$ 18 68	\$ 31 25
Total					\$ 590 86

GOVERNMENT HOUSE AND PUBLIC BUILDINGS.

42. The usual attention was paid to the Gardens and lawns, which were maintained in order throughout the year. Seedlings for the flower beds and borders were supplied from the Nursery periodically. A special consignment of seeds was obtained from England, but the majority of the plants raised unfortunately proved to be not suited to local conditions.

E. B. MARTYN,
Superintendent, Botanic Gardens.

January 14, 1932.

DEPARTMENT OF AGRICULTURE.

REPORT OF THE ENTOMOLOGICAL DIVISION FOR THE YEAR 1931.

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REPORT OF THE ENTOMOLOGICAL DIVISION FOR THE YEAR 1931.

STAFF.

F. A. Squire, B.Sc. (S.A.), F.E.S.—Supernumerary Entomologist.
C. Williams. —Entomological Assistant.
B. J. Ramotar. —Laboratory Assistant.

GENERAL.

The post of Supernumerary Entomologist came into being as a result of the temporary secondment of Mr. L. D. Cleare, Government Entomologist, to carry out Moth-Borer research work. Duty was assumed on July 9. The first three weeks were spent in visiting various parts of the coast in order to become acquainted with local agricultural conditions. Particular attention was paid to the rice mills and coconut plantations.

2. The Division was unfortunate in losing temporarily the services of Mr. C. Williams who was compelled to take four weeks' sick leave from September 12 to October 12, followed by three months' leave of absence from November 16, 1931.

3. *Plant Protection Service Inspection and Fumigation.*—Several consignments of seeds imported into the Colony were fumigated by the Division.

One consignment of three boxes of orchids exported to Venezuela was inspected and declared free from insect pests.

Four shipments of pineapple tops and suckers imported into the Colony were examined for insects.

Two consignments of sugar cane-tops from Porto Rico were inspected and passed to the Quarantine Station.

4. *Collections.*—Considerable additions were made to the collection from time to time and several hitherto unrecorded species sent to the British Museum for identification.

The work of re-arranging the collection, hitherto arranged according to a numerical index, into families was begun. The collection in alcohol has been completed and the dry collection is well under way. Unfortunately, there is a shortage of insect drawers and cabinets which is proving a serious handicap to the building up of a first-class collection. The same congestion is apparent in the entomological library.

Life-history work was carried out in the laboratory with insects collected from time to time, especially on insects likely to become economically important.

An entomological exhibit was got up for the Centenary Exhibition showing some of the principal insect pests of the various crops in the Colony, their life-history and methods of controlling them.

A similar exhibit of the rice pests of the Colony was arranged for the School Children's Fair on the West Bank.

A system of cataloguing and indexing references to entomological literature was started.

PRINCIPAL CROPS.

Sugar Cane.

5. Towards the end of October, a severe outbreak of hardbacks occurred on the East Bank and East Coast, Demerara. Cane-fields form an ideal breeding ground for these insects when the soil is fairly loose and not too dry. The cane-

tops were attacked at the node by the larvæ and killed and had to be replaced by fresh planting material by the supply gangs.

Flooding the fields was found to be very effective against these insects. Those parts that could not be covered by water were handpicked. Apart from the damage done to the cane-tops, the presence of hardbacks in a field is probably beneficial since they pass a good deal of soil through the intestines.

Rice.

6. In September, a rice stem-borer was reported to be present in small numbers in Wakenaam and in October a severe outbreak occurred on the East Coast at Unity-Lancaster village. This was the common rice stem-borer *Diatraea saccharalis*.

Visits were paid to the field at Unity. Flooding was recommended in some cases. It was calculated that this means would kill off the younger larvæ in the lower portions of the stem.

At the end of October, the Experimental Station, Demerara, was invaded by another stem-borer of rice (*Scirpophaga* sp.). As the moth is conspicuous, though small, it was immediately reported by the Agricultural Superintendent. The egg-mass likewise is very conspicuous on the young rice plants. Gangs of boys were put on to gather these egg-masses which were found to be parasitised. They were therefore left in the field in gauze-topped jars until the parasites had emerged.

Slight infestation of rice caterpillar and padi bug occurred during the latter half of the year.

A visit was paid to Beterverwagting in connection with chlorosis of the young rice plants. The roots were examined and the rice water weevil found, but I am by no means convinced that the yellowing of the leaves is due to this insect.

The rice weevil is the most important pest connected with the rice industry and has received special attention since the mid-year. Conditions have been studied in the mills and warehouses and experiments conducted in the entomological laboratory with various fumigants and repellants. The life history of the insect has been worked out almost completely. It has been found that the high atmospheric humidity prevailing in British Guiana has an important bearing on the problem.

Coconuts.

7. The coconut caterpillar has been present on different parts of the East Coast throughout the whole year. In several cases the pest was found to be very active and rapidly increasing. Attempts to control the insects by means of collecting gangs have been made fairly regularly on two estates on the East Coast. While this work is effective on a small scale, and certainly helps to keep down the pests within a circumscribed area, the effect on the general incidence of the pest must be negligible since no co-operation is forthcoming from the rest of the estates and small holdings on the East Coast, which remain breeding grounds and sources of infection.

Visits were paid periodically to estates and small holders on the East Coast by the Entomologist or the Entomological Assistant and strenuous efforts made to induce the people to undertake the work of collecting and destroying nests. For this purpose, the Agricultural Instructor on the East Coast was co-opted at intervals when his other duties were not too pressing.

It was found, however, that in the absence of direct supervision, no effort was made to destroy the nests. The conclusion reached was that the pest is too important to leave entirely in the hands of the agricultural population for three reasons—

- (i) on account of their inexperience ;
- (ii) their unwillingness to spend money on an unremunerative crop ;
- (iii) their inability to co-operate.

No systematic attempt has hitherto been made to control this pest. At present it is maintained in a state of equilibrium by natural causes. If an outbreak should occur through the shifting of these causes, we have only the most primitive method of combating it, viz., handpicking—with few experienced gang overseers.

At present there is no intelligence service apart from the agricultural officers to keep the Division informed of outbreaks of the pest. If every owner of coconuts were compelled to notify the Department of the presence of caterpillars on his holding, the problem would be greatly simplified.

Advice has been given from time to time regarding “cockles” (*Strategus alæus*, Fabr.) in young coconut palms.

OTHER CROPS.

8. *Citrus*.—Towards the end of July a report was received from the Agricultural Instructor that the citrus at Beterverwagting was being attacked by a fruit fly. A trip was made up the canal at Beterverwagting and the fruit growing areas inspected. Visits were also paid to other places on the East Coast where citrus trees were to be found. Oranges were brought into the laboratory and kept under observation. No fruit fly was recorded.

9. *Pineapples*.—Reports reached the Division of fruit fly attack. Pineapples from Canal No. 1, West Bank, Demerara, were bought in the Stabroek Market and kept under observation. Two months after, a fly of the fruit fly family emerged. So far, the insect has not been found to injure the fruit. The pineapple bug is likely to become an important insect pest of pineapples. Experiments are being planned in connection with its control.

PUBLICATIONS.

10. During the six months, July to December, the following publications were made:—

“A Preliminary Report on the Rice Weevil.”	} In Agric. Jour. of B.G.
“Note on the Control of Coconut Caterpillar.”	
“The Preparation of Coffee” (A translation).	
} Vol. IV., No. 3—	
} Sept., 1931.	
An Article on “The Control of Rice Stem-Borer— <i>Diatraea saccharalis</i> ”	
published in the local press under the title of “Agricultural Notes.”	

F. A. SQUIRE,
Supernumerary Entomologist.

December 31, 1931.

DEPARTMENT OF AGRICULTURE.

REPORT OF THE LIVESTOCK DIVISION FOR THE YEAR 1931.

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REPORT OF THE LIVESTOCK DIVISION FOR THE YEAR 1931.

STAFF.

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W. Khan —Foreman.

GENERAL.

During the year the position of the stock industry of the Colony has been investigated by a Cattle Committee, appointed by His Excellency the Governor, and also by the Chief Veterinary Adviser to the Colonial Office who visited the Colony for this purpose. The Committee and the Chief Veterinary Adviser rendered reports which have since been published as Sessional Paper No. 16/1931 and Colonial Advisory Council Report No. 85 respectively.

A tour of the Rupununi savannahs and the cattle trail was made during the early part of the year. A report of this tour has been published in Sessional Paper No. 6/31.

Attendance has been given to Police horses and Government stock, and imported animals have been inspected at the various wharves.

ANIMAL HUSBANDRY.

2. *Cattle*.—Three years ago stud bulls belonging to the Government were stationed in the districts at various points. Although it was known that in other countries this system of posting bulls at stud had been unsuccessful the system was continued for one year. A careful investigation of the results obtained showed that this system was no more successful in this Colony than in other countries. It was impossible to prove the bulls as sires. It was difficult to trace the progeny. Any type of cow was used for breeding purposes. Some of the bulls were mishandled and improperly fed, and in some districts the farmers refused to take their cows to the bull, but expressed a wish for the bulls to be turned loose amongst the herds of cattle on the unenclosed savannahs. It was evident that the stock-owners had no intention of practising selection when breeding and were disinclined to abandon their haphazard methods of stock rearing.

3. It was then decided save in exceptional circumstances to concentrate the stud bulls in Georgetown where they could be kept under constant supervision, until such time arrived that it might be possible to establish Government controlled livestock centres in the districts. The new system of management has been a success.

The selection of cows brought to the bulls for breeding purposes has not been unduly strict because it was realised that the stock-owners must learn gradually to appreciate the benefits of selection.

4. The interest shown in the milk yields and the general condition and quality of the cows brought for service has been appreciated. The owners of the progeny of Government bulls take a pride in their animals; they are carefully reared and proper attention is given to the parent-stock. In the vicinity of Georgetown there is distinct improvement in cattle management. Many young half-bred stock are now being reared. Slow but steady progress is being made with dairy stock.

5. The position as regards beef cattle in the Colony is far from satisfactory. There are several owners of large herds, but for many years the cattle have been allowed to breed indiscriminately; no improved sires have been imported. The herds have deteriorated. In a sense, the natural resources of the Colony have been a handicap—stock-breeding and rearing have been too easy. Lacking the stimula-

tion of difficulties to be overcome, stock-owners have lost interest in their animals and have neglected them. In spite of their inferiority these cattle have yielded a profit because a local market, which has given much higher prices than world-market prices, has been available. Absence of competition has apparently lulled stock-owners into a false feeling of security. Changing conditions have passed unnoticed. The cattle have increased in number out of all proportion to their demand locally.

6. Practically the same methods of breeding and rearing have been practised in the hinterland as on the coast; and these cattle of the interior have been brought down to supply the local market. The local market is now glutted with inferior stock. In the meantime other countries have improved their stock, and the world-markets are not prepared to accept inferior stock except at such low prices as to make dealing in this class of stock scarcely profitable. The Colony is now faced with the problem of having more cattle than can be consumed locally, and no profitable export market for inferior stock.

7. Before the stock-industry of the Colony can be placed on a firm foundation some means of reducing the number of inferior cattle and of increasing the number of superior stock must be found. Lack of co-operation amongst stock-breeders is a serious handicap. The Cattle Association should make every effort to obtain co-operation.

8. A temporary relief to the present impasse could be obtained if cattle-owners pooled their resources and made an effort to enter an export market with the best cattle in their possession. Small and irregular consignments of cattle do not help to make a market. With pooled resources it should be possible to export one or two thousand head of cattle of a class which would be acceptable in an export market.

9. Permission has been granted to experiment with the importation of a limited number of selected Brazilian cattle which are to be grazed on our pastures for a certain period before being exported. If this experiment proves successful and these cattle can be exported in good condition, it should be possible to obtain a secure footing in an export market to which our best locally bred and reared cattle can be sent and sold at a reasonable profit.

10. There is no way to reduce rapidly the number of inferior animals, except at a dead loss. The reduction will have to be gradual. Without a factory, which could make use of inferior animals, the only means to reduce their number is to cease breeding from them. The many scrub bulls should be eliminated. Bulls approved as sires should be used only with selected breeding stock.

11. At this period of depression the retail price of meat should be lower. Stock-owners selling their inferior animals at world-market prices for this class of stock would not suffer unduly heavy loss—there would be no overseas freight to pay. To make the best of our present cattle, experiments with stall-feeding should be carried out. Attempts to fatten selected young cattle with sugar-cane tops, Guatemala grass, and molasses should be made. Sugar planters might co-operate with cattle-owners in these experiments. Perhaps each sugar estate could accommodate 25 head of cattle. Stock-owners on the coast might make further experiments with cultivating and feeding Guatemala grass alone. Rupununi ranchers should restrict the number of cattle they bring down to the coast to a number which they are certain they can provide with food and water.

12. *Pigs.*—The position of the pig industry is no more satisfactory than that of beef cattle. A considerable amount of pork is consumed in the Colony, but no pig-breeder is satisfied with the prices he receives from the butcher. Under these conditions the quality of pork which is retailed cannot be expected to be good. At its best it is merely a change of diet; the pig has done its best with its ration of

rice dust and molasses. The pig is omnivorous, but this should not be interpreted as meaning that the pig will eat anything and do well. A pig requires as much care as any other farm animal, and to be profitable probably requires more care.

13. It is possible to feed pigs on a cheap ration which can be obtained locally, but unfortunately the average pig-keeper is inclined to treat a special ration for a pig as a matter for ridicule. Pig-keepers must realise that a pig is not all profit, and butchers should pay prices according to the quality and condition of the animal.

14. *Poultry*.—The Poultry Association staged a show of standard bred birds in October. The exhibits were a credit to their owners. Whether one was a novice or a poultry-keeper of experience the show was well worth a visit. The show attracted general interest, and from the point of view of an exhibition it was a success.

15. Most of the members of the Association keep poultry as a hobby, but they are keen to establish a poultry industry. It is realised that an industry of any size cannot be run by a few people keeping birds as a hobby. A large increase of members who are willing to help to make a profitable industry is required. Unfortunately, the show attracted few new members. Poultry-fanciers are enthusiasts, however, and the failure to enrol many new members of the Association, although disappointing, will not stop progress being made.

16. Many valuable birds have been imported, and data concerning the results obtained are being collected. Eggs for hatching and young birds have been despatched to every district in the Colony. Good results will follow in the course of time.

ANIMAL HEALTH.

17. No large outbreaks of contagious and infectious disease have been reported. Sodium Cacodylate as a cure for Anaplasmosis contracted by imported cattle continues to be wholly successful.

STOCK FARM.

18. *Cattle*.—Three bulls and two heifers, all pedigree Holstein-Friesians, were imported from Canada. Government cattle now consist of five bulls, four cows, four heifers, and two heifer calves—all Holstein-Friesians. The last consignment imported was reported in Canada as being one of the best exported from that country. This is interesting in that it was possible to compare two imported animals with two born in the Colony of equal age.

19. The Creole Holstein-Friesians showed equal growth and quality to the imported cattle. It is unusual to obtain the same growth in the Tropics as in temperate climates—it is further proof that the Colony is suitable for stock. All the imported cattle have been grazed on tick-infested pastures and treated for anaplasmosis when necessary. They are now thoroughly acclimatised.

20. *Pigs*.—Young pigs have been sold to farmers and others. An auction sale held at the end of the year was not a success on account of poor attendance and consequently, only a few animals were sold. A number of excellent boars and sows are on hand for sale.

21. *Donkeys*.—The services of the stallion donkey are not in demand. It is suggested that this donkey should be tried with horse mares for mule breeding.

22. *Poultry*.—There are now five pens of poultry on the farm. This is a section which should be extended. During the year 847 selected eggs were sold for hatching purposes, and 1,260 eggs, not suitable for hatching, were sold for table purposes. 37 young cockerels were sold. There is a great demand for eggs and young birds. Several more pens are required, and a hatchery would be a great asset.

23. *Working Oxen*.—The working oxen of the Experiment Station are grazed on the farm. These are young animals which show excellent condition and growth on limited grazing without supplementary rations.

FODDER PLANTS.

24. *Guatemala Grass*.—The cultivation of this grass has been extended, and it has proved to be of great value. Thousands of slips of this grass have been despatched to various parts of the Colony by the Agricultural Superintendent, East Demerara, and by Mr. Sills who first introduced this grass to the Colony. It grows luxuriantly on both sandy and heavy soil and offers a solution to the problem of obtaining forage by stock-owners who own limited grazing. It is fodder which should be grown near every corral on the Cattle Trail.

25. *Demerara Primrose*.—It is interesting to note that this is a useful fodder plant in the Seychelle Islands during periods of drought

During the last dry season this plant continued to grow luxuriantly in the Botanic Gardens when grass was scarce. In the Gardens it has spread naturally away from the shaded areas where it was first concentrated. Attempts to grow it on sandy soil have succeeded.

Seeds and slips have been despatched to various parts of the Colony by the Agricultural Superintendent, East Demerara.

FOOD STUFFS.

26. On the Stock-Farm every effort has been made to feed local products in preference to imported foodstuffs. The rations have been balanced. For cattle, local products have been supplemented with cotton-seed meal imported from Barbados. A cheap and satisfactory ration has been used. Many cattle-owners continue to use imported foodstuffs which are expensive; their attention is drawn to the ration used on the stock-farm and to the results obtained. The pigs on the farm are fed on a purely local ration with satisfactory results. Poultry have been reared from one day old to maturity on a local ration supplemented with imported bran. Their rate of growth has been most satisfactory. The cost of this ration compares most favourably with imported poultry mixtures. Balanced poultry rations of local products can now be purchased in Georgetown. No local merchant has yet produced a balanced cattle or pig meal to compete with the imported so-called oil meals. Many stock-owners would prefer to use local products, but have not the necessary machinery to grind the ingredients of a mixture. Any firm interested in animal foodstuffs is welcome to the prescriptions of the rations used on the farm. The results obtained are equal in every way to those obtained with imported foodstuffs, and the cost is very much less.

MISCELLANEOUS.

27. As in previous years the Agricultural Superintendent, East Demerara, has supplied food-stuffs unsuitable for sale or distribution to farmers for the use of the live-stock.

28. *Revenue*.—Sale of stock, eggs, stud and inspection fees yielded a revenue of \$754.68.

29. *Importation*.—Breeding Stock—

Holstein-Friesian	...	...	5
Holstein-Friesian Bulls	..	...	2
Hereford Bulls	...	...	4
Goats	...	...	5
Sheep	...	...	1
Thoroughbred horse Entire	...	...	1

January 14, 1932.

T. BONE,
Government Veterinary Surgeon.

The second of the two main parts of the book is devoted to a study of the various forms of the verb 'to be' in the different dialects of the English language.

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